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Report

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Report of the Agricultural & Mechanical College … <1877/1878>;

Report of the Board of Trustees of the State Agricultural & Mechanical College … 1878/1879-<1881/1882>

LLMC #: 00269t

REPORT

OF THE

BOARD OF TRUSTEES

—OF THE—

STATE AGRICULTURAL

——AND——

MECHANICAL COLLEGE,

FOR THE YEARS 1880-81, 1881-82.

MONTGOMERY, ALA.:
ALLRED & BEERS, STATE PRINTERS,
1882.

BOARD OF TRUSTEES,

—AND—

TIME OF EXPIRATION OF OFFICE.

RUFUS W. COBB,
Governor, ex-officio President.
H. C. ARMSTRONG,
Superintendent of Education, ex-officio.
FIRST DISTRICT:
C. C. LANGDON, Mobile.
February 28th, 1887.
SECOND DISTRICT:
J. W. HARDIE, Montgomery.
January 4th, 1883.
THIRD DISTRICT:
W. H. BARNES, Opelika.
H. D. CLAYTON, Clayton.
February 28th, 1887.
FOURTH DISTRICT:
JOHNATHAN HARALSON, Selma.
January 4th, 1883.
FIFTH DISTRICT:
R. F. LIGON, Tuskegee.
January 4th, 1883.
SIXTH DISTRICT:
JOHN W. BISHOP, Talladega.
January 4th, 1883.
SEVENTH DISTRICT:
M. L. STANSELL, Carrolton.
January 4th, 1885.
EIGHTH DISTRICT:
J. N. MALONE, Athens.
January 4th, 1885.

E. T. GLENN, Treasurer.
F. M. REESE, Secretary.

ACT OF CONGRESS.

An Act donating Public Lands to the several States and Territories which may provide Colleges for the benefit of Ariculture and the Mechanic Arts.*
(Approved July 2d, 1862.)

SECTION 1. *Be it enacted by the Senate and House of Representatives of the United States of America in Congress Assembled.* That there be granted to the several States, for the purposes hereinafter mentioned, an amount of public land, to be apportioned to each State, a quantity equal to thirty thousand acres for each Senator and Representative in Congress to which the States are respectively entitled by the apportionment under the census of eighteen hundred and sixty; *provided*, that no mineral lands shall be selected or purchased under the provisions of this act.

SECTION 2. *And be it further enacted*, That the land aforesaid, after being surveyed, shall be apportioned to the several States in sections or sub-divisions of sections, not less than one quarter of a section; and whenever there are public lands in a State, subject to sale at private entry, at one dollar and twenty-five cents per acre, the quantity to which said State shall be entitled shall be selected from such lands within the limits of such State, and the Secretary of the Interior is hereby directed to issue to each of the States in which there is not the quantity of public lands subject to sale at private entry at one dollar and twenty-five cents per acre. to which State may be entitled under the provisions of this act, land scrip to the amount in acres for the deficiency of its distributive share; said scrip to be sold by the State, and the proceeds thereof applied to the uses and purposes prescribed in this act, and for no other use or purpose whatsoever; *provided*, that in no case shall any State to which land scrip may thus be issued be allowed to locate the same within the limits of any other State, or of any Territory of the United States, but their assignees may thus locate said land scrip upon any of the unappropriated lands of the United States subject to sale at private entry at one dollar and twenty-five cents, or less, per acre; *aud provided, further*, that no such location shall be made before one year from the passage of this act.

SECTION 3. *And be it further cnacted*. That all the expenses of management, superintendence and taxes from date of selection of said lands, previous to their sale, and all expenses incurred in the management and disbursement of the moneys which may be received therefrom, shall be paid by the States to which they may belong, out of the treasury of said States, so that the entire proceeds of the sale of said lands shall be applied without any diminution whatever to the purposes hereinafter mentioned.

SECTION 4. *And be it further enacted*, That all moneys derived from the sale of the land aforesaid by the States to which lands are apportioned, and from the sale of land scrip hereinbefore provided for, shall be invested in stocks of the United States, or of the States, or some other safe stocks yielding not less than five per centum upon the par value of said stocks; and that the moneys so invested shall constitute a perpetual fund, the capital of which shall remain forever undiminished (except so far as may be provided in section fifth of this act), and the interest of which shall be inviolably appropriated, by each State which may take and claim the benefit of this act, to the endowment, support and maintenance of at least one college, where the leading object shall be, without excluding other scientific and classical studies, and including military tactics, to teach such branches of learning as are related to agriculture and the mechanic arts, in such manner as the Legislatures of the States may respectively prescribe, in order to promote the liberal and practical education of the industrial classes in the several pursuits and professions in life.

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*United States Statutes at Large, No. 12, folio 503.

SECTION 5. *And be it further enacted*, That the grant of land and land scrip hereby authorized shall be made on the following conditions, to which, as well as to the provisions hereinafter contained, the previous assent of the several States shall be signified by legislative acts:

First.—If any portion of the fund invested, as provided by the foregoing section, or any portion of the interest thereon, shall, by any action or contingency, be dismissed or lost, it shall be replaced by the State to which it belongs, so that the capital of the fund shall remain forever undiminishod, and the annual interest shall be regularly without diminution devoted to all purposes mentioned in the fourth section of this act, except that a sum, not exceeding ten per centum upon the amount received by any State under the provisions of this act, may be expended for the purchase of lands or sites or experimental farms, whenever authorized by the respective Legislatures of said States.

Second.—No portion of this fund, nor the interest thereon, shall be applied, directly or indirectly, under any pretense whatever, to the purchase, erection, preservation or repair of any building or buildings.

Third.—Any State which may take and claim the benefit of the provision of this act shall provide, whithin five years at the latest, not less than one college, as described in the fourth section of this act, or the grant to such State shall cease; and said State shall be bound to pay the United States the amount received of any lands previously sold, and that the title to purchasers under the State shall be valid.

Fourth.—An annual report shall be made regarding the progress of each college, regarding any improvements and experiments made, with their costs and results, and such other matters, including State industrial and economical statistics, as may be supposed useful; one copy of which shall be transmitted by mail, free, by each to all the other colleges which may be endowed under the provisions of this act, and also one copy to the Secretary of the Interior.

Fifth.—When lands shall be selected from those which have been raised to double the minimum price, in consequence of railroad grants, they shall be computed to the State at the maximum price, and the number of acres proportionately diminished.

Sixth.—No State while in a condition of rebellion or insurrection against the government of the United States, shall be entitled to the benefit of this act.

Seventh.—No State shall be entitled to the benefit of this act unless it expresses its acceptance thereof by the Legislature within two years from date of its approval by the President.

SECTION 6. *And be it further enacted*, That the land scrip issued under the provisions of this act shall not be subject to location until after the first day of January, 1863.

SECTION 7. *And be it further enacted*, That the land officers shall receive the same fees for locating land scrip issued under the provisions of this act, as is now allowed for the location of military bounty land warrants under existing laws; *provided*, their maximum compensation shall not be thereby increased.

SECTION 8. *And be it further enacted*, That the Governors of the several States to which scrip shall be issued under this act, shall be required to report annually to Congress all sales made of such scrip until the whole shall be disposed of, the amount received for the same, and what appropriation has been made of the proceeds.

N. B.—The act of July 23, 1866, extends the time for accepting the benefits of the preceding act for three years, *i. e.*, to July 29, 1869; and the act of January 23, 1873, further extends it to July 1, 1874.

ACTS OF THE STATE LEGISLATURE.

By an act approved December 31st, 1868, the Legislature accepted the land grant under this law. July 11th, 1871, Gen. Lindsay, Chairman of the Board of Commissioners appointed by the Legislature to invest this fund, reported that on June 23d, 1871, he had received land scrip to the amount of 24,000 acres, and had sold the same at ninety cents per acre, making $216,000. The Auditor was instructed to invest the proceeds of this land scrip in Alabama, 8 per cent. bonds at a price agreed upon, to-wit eighty-five cents on the dollar.

By an act approved February 26, 1872, the Legislature accepted the proposition of the Trustees of the East Alabama College, donating to the State the College building, property, and lands, upon the condition that the Agricultural and Mechanical College should be located at Auburn. March 20, 1872, the Trustees met at Auburn, elected a Faculty and organized the College. July 26, 1872, application was made to the State Treasurer for the first payment of the semi-annual interest. Bonds to the amount of $59,500 were in the State Treasury; only $2,560 interest was received.

By order of Gov. Lewis in 1873, the remainder of the bonds due the College under the contract made by the Commissioners was deposited in the State Treasury, making a sum total of $253,500 8 per cent. bonds. The July, 1872, coupons had been detached from these bonds before they were delivered. Since these bonds have been deposited in the State Treasury, the interest has been paid by the State. Up to 1879 it was paid in Alabama State Certificates; since that time it has been paid in currency.

OBJECT OF THE COLLEGE.

In accordance with an act of Congress of July 2, 1862, to which the Agricultural and Mechanical College owes its existence, the annual income arrising from the Congressional land grant must be appropriated to the "support and maintenance of at least one College wherein the leading object shall be, without excluding other scientific and classical studies, and including military tactics, to teach such branches of learning as are related to Agriculture and the Mechanic arts." The *leading object* of this College is thus clearly defined, and it is the object of the Trustees, with which the Faculty are in accord, to make it a distinctive Scientific Institute, and not a classical or literary College. It is designed not to make prominent those literary subjects that properly belong to the State University, but to supplement and complete the educational work of the State, by giving especial prominence and attention to the sciences and their applications. This special educational work of the Agricultural and Mechanical College, we deem of great importance to the present and future development of the State, and not in any manner in conflict with that belonging to any other State institution.

DONATIONS TO THE STATE.

The College with its building, grounds, apparatus for instruction, and endowment has up to the present time not cost the State of Alabama one dollar. All it possesses was a free gift to the State.

Its endowment was a gift from the Federal government by the act of Congress of July 2, 1862, set apart "in order to promote the liberal and practical education of the industrial classes," not one dollar of interest or principal of which can be used either directly or indirectly for building or repairs.

The College building, an excellent brick edifice, one hundred and fifty by seventy-five feet, with four stories, containing in all thirty-eight rooms, including two well furnished society halls, lecture rooms and offices, with chemical laboratory, cabinets and Agricultural museum, as well as the grounds attached, was the gift of the Methodist Episcopal Church South, through the Alabama conference, to the people of the State.

This gift to the State, cost the donors more than $100,000.

In addition to a small plat of sixteen acres bought by the authorities of the College for experimental purposes, it owns a field of eight acres, the gift of the citizens of Auburn.

With this free gift of buildings and endowment, the College has in the past eleven years matriculated nine hundred and one students, and now numbers among its alumni ninety-four graduates. We do not know of any State institution that has accomplished so much valuable educational work without cost to the people of the State. While the State has made just, and as far as her ability would permit liberal appropriations for the support of her common schools, she has left her University and her Agricultural and Mechanical College, representing the higher education, to languish for support and assistance.

WANTS OF THE COLLEGE.

But the time has come when the State should extend her fostering care to this College, in order that her sons may have within her own limits an institute thoroughly equipped to teach science in its principles and applications as well in Alabama as elswhere. We should no longer be content with simply continuing to do the best that can be done with the limited means furnished by others. We should help ourselves.

The official statistics show in what manner other States have helped themselves.

The amount of money received from State appropriations by thirty-three of the Colleges established by the United States land grant is now largely in excess of four million of dollars, making an average of more than a hundred and thirty thousand dollars appropiated by each State to its Agricultural and Mechanical College.

The need of well trained civil, mining, and mechanical engineers, of expert geologists, mineralogists and chemists, of agriculturists, mechanics, manufacturers and merchants, well trained by the discipline of science-education for their different vocations, is so obvious as to require no argument at this day to demonstrate their importance and value to the State.

We do not deem it necessary to repeat the arguments, with which all thoughtful men are familiar, demonstrating the prime necessity now upon us, looking to the present and future welfare of our people, of encouraging and expanding our educational institutions. We cannot afford to stand still, when so much is being done elsewhere. We must remember that "that people is the first people who have the best schools; if not to-day, they will be to-morrow."

In fulfilment then of the plan adopted, in accordance with the intent of the act of Congress to which the College owes its existence, and in conformity with the educational demands of the State to make it distinctive in teaching science and its applications, it has, we repeat, now become necessary for its expansion and increased usefulness, that it should be more completely provided with all requisite facilities for successful instruction in the varied departments of industrial education.

Hence, we respectfully report to the Legislature of the State that to accomplish the ends deemed of inestimable value, by placing the College in more complete sympathy with the educational demands of the age, means will be required for the following purposes:

1. To obtain a more complete equipment to illustrate the principles and application of science in the various departments.

2. To expand the department of experimental agriculture, in order that experiments of a more varied and extensive character may be made at the College, and also at experimental stations in different representative portions of the State, for the benefit of the agricultural community generally.

[And in support of this, we beg leave respectfully to refer to the developed argument contained in the report of the trustees of the College to the last Legislature.]

3. To enlarge the library and furnish it with books suitable for students and faculty. No college can be expected to do first-class educational work without a well furnished library.

4. To furnish the lecture and recitation rooms with necessary and suitable furniture.

5. To make necessary repairs on the present college building, now absolutely required for its continued preservation, and to construct other necessary buildings.

We may be excused for again calling attention to the fact that this building was a gift to the State, and that to preserve it from serious and permanent injury, it requires to be painted and well stuccoed, and to have its roof repaired; and also for reminding your body that the College possesses no houses for its president or professors, and no audience-room for public exhibitions, and is prohibited by law from appropriating one dollar of interest or principal of its endowment for buildings or repairs.

CHANGES IN THE FACULTY.

Since our last report there have been several changes in the faculty of the College.

The first of July, 1881, Colonel W. H. Chambers, professor of agriculture, died.

Before his connection with the College he was widely known and held in high esteem over the entire State, having filled many important public positions, both in church and state. In every relation of life, both public and private, he was a true and noble man. As professor of agriculture he took a deep interest in his work, and had commenced the development of his department with such wisdom that it would have proved, when fully developed, of great value to the State. His broad and liberal views of the purposes of the institution, his general culture, and his wide influence, made him a valuable officer in the general work of the College.

In September following, Colonel R. H. Hardaway resigned the chair of engineering and the position of commandant—offices which he had so well and acceptably filled.

These vacancies occurring after the adjournment of the Board of Trustees, necessitated the distribution of the work of their chairs among the remaining members of the faculty. The work was much more successfully accomplished than could have been anticipated.

At the close of the session 1881–1882, the president, Rev. I. T. Tichenor, D. D., tendered his resignation, to enter upon other duties—thus dissolving the pleasant relations which had existed between him and the board from the organization of the College; and we here take occasion to express our high appreciation of his services in connection with the responsible duties of his position.

But, the board esteem themselves fortunate in filling the vacancies thus occurring. At its last session it elected Wm. Leroy Broun, LL. D., to the presidency, and General Jas. H. Lane to the chair of engineering, and commandant. Dr. Broun is widely known as a distinguished educator and scientist. His large and successful experience, and his established reputation as a professor in the institutions of the highest grade, notably in the universities of Georgia and Vanderbilt, give assurance that the usefulness, character and influence of the college will continue to increase under his administration. His successful organization and management of the Agriculture College of Georgia while its president, gives hope of the enlargement and development of this department of the College.

General Lane, a graduate of distinction in the Virginia Military Institute, and a brigadier-general during the late war, brings large experience and established reputation to his department. To his military knowledge, thus acquired, he adds the experience of several years as commandant in the Agricultural College of Virginia. The responsible duties of commandant have thus been entrusted to one of large and successful experience.

To the duties of the chair of engineering he brings the training acquired at the institute, and also in the course of engineering of the University of Virginia. He has filled that and related chairs in North Carolina Military Academy, Agricultural College of Virginia, and the school of mines in the University of Missouri. We feel assured that the high reputation of the department of engineering will be fully maintained and extended.

CADETS IN ATTENDANCE AND GRADUATES DURING THE PAST TWO YEARS,

The number in attendance was in 1880–1	185
The number in attendance was in 1881–2	122
The number of graduates in 1881 was	15
The number of graduates in 1882 was	13

A majority of the graduates—inquiry has shown—is engaged in those pursuits for the promotion of which this institution was designed.

It may not be improper to give a brief resume of the work of the College since its organization:

The entire number of matriculates in the College is	901
The number of graduates with the degree of Bachelor of Scientific Agriculture is	16
With the degree of Bachelor of Science is	11
With the degree of Bachelor of Engineering is	36
With the degree of Bachelor of Arts is	31

Making in all a total of ninety-four graduates.

The disproportion between the number of matriculates and the number of graduates arises from the fact that a large number of young men avail themselves of the benefits of the College for two years only, and then enter upon active life. A course has been arranged to accommodate this class of students, and provision is now made for confering a certificate upon those completing this course with distinction. There is one fact that shows the improvemant in the character and advancement of the students entering the College—that is, the constantly increasing percentage of those entering the regular college courses.

In 1879–80, sixty seven per cent. of all the students were in the regular college classes studying for degrees; in 1880–81 there were seventy-six per cent.; in 1881–82, seventy-five per cent.; and at present, eighty-three per cent.

GEOLOGICAL AND MINERALOGICAL CABINET.

In the past two years valuable additions have been made to the Geological and Mineralogical Cabinet by contributions from different States of the Union, from England, Italy, France, and elsewhere in exchange for the remarkable Claiborne fossils which exist in such large quantities in Alabama. This system of exchanges was inaugurated by the Professor of Natural History and Geology, who reports that he has received within the past two years, 12,756 fossils, 2,199 minerals, 2,070 shells and corals, 474 Zoological specimens, and 1,577 Botanical specimens; making the entire collection now in the Cabinet of the College more than 23,000. This large collection is due mainly to the labor and industry of the Professor in charge of that department.

MUSEUM OF MECHANIC ARTS.

Some progress has been made in establishing a Museum of

Mechanic Arts. Already there has been collected a number of the products of manufacture giving excellent illustrations of various branches of industry. It is proposed to make this an important feature in the College by exhibiting as far as possible the various processes and products of manufacture.

MUSEUM OF AGRICULTURE.

The Agricultural Museum is intended to illustrate as far as possible the agricultural products of this and other countries. It now contains, (though only begun last session), nearly seven hundred specimens, obtained by donations and by a system of exchanges with other Agricultural Colleges, illustrating varieties of soils, cotton, wheat, oats, corn, peas, garsses, &c.

EXPERIMENTAL AGRICULTURE.

After the death of Col. W. H. Cahmbers, the duties of this important department were assigned to Prof. W. C. Stubbs. In addition to his duties as Professor of Chemistry, he has with very limited means at his disposal made a number of valuable experiments in agriculture. The results of which with other information of value to farmers, are stated in full in his report to the Trustees. This report of the work done in experimental agriculture is deemed of such value to the State that it is hereby made a part of the report of the Trustees to the Legislature, and its publication and general distribution I recommended.

DEPARTMENT OF MILITARY SCIENCE.

By the act of Congress for the endowment of Agricultural and Mechanical Colleges, in prescribing the required studies, the words "*including* military tactics" are used. The act is faithfully carried out, by imparting to each student, not physically incapacitated to bear arms, practical instruction in the school of the soldier, of the company, and of the battalion. The duties of guards, outpost and picket service, are practically taught. The College is provided, by the State, with breech-loading rifles, swords and accoutrements. The Commandant reports on hand one hundred and ninety-three bright breech-loaders with accoutrements. Recently there were delivered to the Ordnance Sergeant of the State, by order of the Governor, ninety-three bronze breech-loaders. The Commandant recommends the exchange of the arms on hand for light Cadet muskets and accoutrements, which recommendation is hereby approved.

ORGANIZATION OF FACULTY.

The present organization of the Faculty is as follows:

WM. LEROY BROUN, M, A., LL.D.,
President and Professor of Agriculture.
J. T. DUNKLIN, A. M., LL.D.
Professor of Ancient Languages.
W. C. STUBBS, A. M.,
Professor of General and Agricultural Chemistry.
OTIS D. SMITH, A. M.,
Professor of Mathematics.
P. H. MELL, JR., M. E. PH. D.
Professor of Natural History.
REV. G. W. MAXSON, A. M., M. E.,
Professor of Moral Philosophy and English Literature.
GEN. J. H. LANE, C. E., M. A.,
Commandant and Professor of Engineering.
C. C. THACH, C. E.,
Instructor of Ancient and Modern Languages.
F. H. FRAZER, B. E.,
Instructor.
J. H. DRAKE, M. D.,
Surgeon.
WILLIAM C. SUBBS, A. M.,
Secretary of Fcaulty.
E. T. GLENN,
Librarian.

COURSES OF INSTRUCTION.

There are four regular Degree Courses designated as follows:

I.

COURSE IN AGRICULTURE.

Degree, Bachelor of Scientific Agriculture; B. S. A.

II.

COURSE IN ENGINEERING.

Degree, Bachelor of Engineering; B. E.

III.

COURSE IN LITERATURE.

Degree, Bachelor of Arts; A. B.

IV.

COURSE IN SCIENCE.

Degree, Bachelor of Science; B. S.

Each of these Courses requires four years for its accomplishment, and to entitle the student to the Degree he must stand an approved examination in the studies prescribed for the Course. For the first two years the studies in all of the Degree Courses (which are the same as those pursued in the Freshman and Sophomore Classes of other Colleges) are identical, except that students in the Departments of Agriculture, Engineering and Science, may, if they prefer, substitute the Modern Languages (French and German) for Latin and Greek. Having completed the studies prescribed for these two years, the student may select either of the Regular Degree Courses.

I.—COURSE IN AGRICULTURE.

The design of this Course is to furnish the student with a plan of study especially adapted to the wants of those who propose to devote themselves to Agricultural pursuits; not so much by training in the practical processes of the farm, as by affording instruction in the principles of correct husbandry, and in those sciences which relate particularly to the cultivation of the soil.

The Course requires four years for its completion, the first two years, however, being devoted to studies which are common to the Literary Course, except that students who propose to take the Course in Agriculture may, if they prefer, substitute the Modern for the Ancient Languages.

Having gone through this course of study, which is thought to be essential to a liberal education for any of the practical pursuits of life, the student is prepared to enter upon the technical studies in the course, which occupy the remaining two years. These technical studies embrace the following subjects:

1. *Mechanics and Physics*, in which the class makes three weekly recitations during the first year.
2. *Botany*, two recitations weekly the Spring terms of the first and second years.
3. *Descriptive Astronomy and Meteorology*, three recitations weekly during the second year.

4. *Geology and Mineralogy*, the first three and the second two recitations weekly during the second year.

5. *Zoology and Entomology*, three recitations, weekly, throughout the second year.

6. *Agricultural Chemistry*, with practical instruction in quantitative and qualitative analysis of soils and fertilizers, to which two hours are devoted daily during the first year.

7. *Vegetable Physiology*, embracing the structure and habits of plants, and their relations to the soil and the atmosphere, occupying two recitations weekly during the first year.

8. *Cattle Feediny*, embracing the principles of animal nutrition, the chemical and economical value of feeding stuffs; two recitations weekly during the Spring term of the first year.

9. *Pratical Husbandry*, embracing the subjects of soils, their cultivation, fertilization, drainage and irrigation; Farm Crops; Farm Implements and Machinery; Farm Animals; Fruit Culture; Market Gardening; Horticultural and Landscape Gardening; in which instruction is given daily by text books and lectures during the entire course of two years.

I I.—COURSE IN ENGINEERING.

This Course extends the Scientific Course in Applied Mathematics, and embraces full instruction in regard to the construction of common roads, pikes, railroads, bridges, canals, improvements of rivers, harbors, mining, &c.

Tbe work in this Course begins with the first Collegiate term.

The Course in Drawing extends through four years. During the first year the students pratice linear and freehand drawing. In the second year the elementary principles of instrument drawing, embracing a course of orthographic and isometrical projections, shades and shadows, structural drawing and topographical delineation, are taught.

During the third and fourth years, instruction in drawing is obligatory only on the students in Engineering. In the former year the system of instruction embraces orthographic projections, isometric drawing, shades and shadows, tinting in India ink and colors, the practice of drawing in sketches of tools, the finished work of machines, bridges and other structures. In the last, or fourth year of the Course in Engineering, the students are taught perspective. They then cease to draw for practice, and use their graphical skill in machine construction, in making drawings of works visited in excursions to mines, furnaces, water, gas and railway structures. Plans, profiles and sections of railroad surveys complete the course.

Students who propose to make Mining a specialty will receive special instruction in the three fundamental branches of the Art—mining, preparation of ores, and their metallurgical treatment.

An ample collection of minerals is provided, comprising all species with which the Mining Engineer should be familiar, and to this, students have constant access. The geology of Alabama, Georgia and North Carolina, where mining is conducted to any extent, is well represented in the Mineralogical Cabinet.

III.—COURSE IN LITERATURE.

This is the usual A. B. Course of American Colleges. It embraces a course of the Latin and Greek Languages, the study of English in its linguistic elements, as well as its Literature, including Rhetoric and Logic; History. Ancient and Modern; Philosophy, Mental, Moral and Political; Mathematics, Pure and Applied; and Natural Sciences, including Chemistry, Botany, Astronomy, Geology and Physics.

IV.—COURSE IN SCIENCE.

This Course is intended for those who wish to pursue the study of the Physical Sciences to a greater extent than prescribed in the Literary Course; with the privilege, at the same time of substituting the Modern for the Ancient Languages.

The subjects embraced are Mechanics and Physics; Botany; Chemistry, including work in the Laboratory in Qualitative and Quantative Analysis, or an equivalent amount of Latin; Descriptive and Practical Astronomy; Mineralogy; Geology and Meteorology; and Mental and Moral Philosophy.

The Chemical Laboratory is well fitted up for work in Analysis. It consists of a lecture room, furnished with counters, pneumatic trough, gasometer and large glass case; a work room with twenty-five work-tables; a furnace room, and a balance room. All are supplied with gas and water. Every student pursuing Analytical Chemistry is provided with a separate work-table, the necessary chemicals and apparatus, a jet of gas with Bunsen's burners, and enameled water sinks. In the balance room are balances made by Oertling of London, and Becker of New York.

LOCATION.

The College is located in the town of Auburn, sixty miles east from Montgomery, directly on the line of the Western Railroad.

The region is high and healthful—821 feet above tide water; being more elevated than Montgomery by 659 feet.

EXPENSES.

The object of the trustees is to make the necessary expenses of a collegiate education at the Agricultural College as small as it possibly can be. For this reason tuition is free. There is no charge made for tuition to cadets from Alabama or from other States. Board is obtained in private families at Auburn at twelve dollars to fifteen dollars per month, and the fees for surgeon, matriculation, &c., amount to ten dollars per term, with two dollars a year for the library.

A cadet who practices economy can pursue his studies for an entire collegiate year and meet all necessary expenses for board, uniform, books, &c., for two hundred dollars.

The following statements show that this has been done:

November 16th, 1882.

Dear Sir.—In reply to your inquiry in regard to my actual expenses while at the Agricultural & Mechanical College, I beg leave to state that I was a cadet in that school during the years of 1874, 1875, 1876 and 1877, and that my actual expenses for board, uniform, books, washing, in fact for everything, were in 1874, ($186) one hundred and eighty-six dollars; in 1875, ($199) one hundred and ninety-nine dollars, and in 1876 and 1877, not over two hundred dollars per session.

Respectfully,

A. B.

November 18th, 1882.

Dear Sir.—I was a cadet of the Agricultural & Mechanical College from January, 1879, to June, 1881, making an attendance of two and three-fourth sessions. My total expenses for fees, board, books, uniform, washing, traveling expenses, including everything during the whole time I was a cadet, were four hundred and sixty-five dollars ($465), making an average of one hundred and sixty-nine dollars and nine cents ($196.09) per session.

Respectfully,

C—— D——.

November 18th, 1882.

Dear Sir.—Upon inquiry I state that I entered the Agricultural & Mechanical College at Auburn, the fith (5th) day of December 1877, and that my expenses, including board, uniform, books and traveling expenses, were $103; in 1878-9, $132, (absent one month); in 1879-80, $132.50, (absent one month); in 1880-81, $156, (absent about three weeks); making my whole expenses during the four years, $523.50.

Very Respectfully,

E—— F——.

TREASURER'S REPORT.

RECEIPTS—1880-1881.

From State Treasurer	$ 20,280 00
Incidental and Surgeon's Fees	2,402 50
Farm	165 89
Expense Account	156 00
	$ 23,004 39

DISBURSEMENTS.

Balance	$ 3,499 53
By amount paid Expense Account	1,246 84
Repairs and Improvements	205 43
Fixtures	45 48
Printing	216 75
Stationery and Records	134 75
Freight	188 99
Interest and Exchange	337 87
Apparatus	48 90
Military	162 70
Trustees	103 50
Salaries	16,585 00
Farm	616 85
Insurance	150 00
Chemicals	237 46
Surgeon	597 50
Advertising	208 20
	$ 24,585 77

NOTE—Disbursements in excess of receipts, $1,581 38.

RECEIPTS FOR 1881-1882.

From State Treasurer	$ 20,280	00
Incidental and Surgeon's Fees	1,727	50
Farm	390	75
Expense	110	00
Chemicals	80	00
Error in Advertising	25	00
	$ 22,613	25

DISBURSEMENTS.

Balance	$ 1,581	39
By amount paid Expense	205	35
Repairs and Improvement	203	15
Printing	170	85
Freight	109	90
Stationery	44	30
Interest and Exchange	166	14
Apparatus and Chemicals	216	93
Military	224	67
Trustees	245	55
Servant hire	156	90
Music	100	00
Salaries	15,635	00
Salaries (back)	1,596	60
Farm (proper)	449	86
Agricultural Museum	98	79
Printing Agricultural Reports	57	50
Postage	94	72
Fuel	149	25
Speakers at Commencement	22	50
Insurance	150	00
Surgeon	460	00
Advertising	201	55
Balance in Treasury	272	34
	$ 22,613	25

Respectfully,

E. T. GLENN, Treasurer.

W. H. BARNES,
President *pro tem.*

F. M. REESE, Secretary.

REPORT

OF THE

AGRICULTURAL AND CHEMICAL DEPARTMENT

OF THE

STATE AGRICULTURAL

AND

MECHANICAL COLLEGE

FOR 1881 and 1882.

BY

PROF. WM. C. STUBBS.

CHEMICAL LABORATORY, A. & M. COLLEGE,
AUBURN, ALA.

Col. Wm. Leroy Brown, LL.D.,
President A. & M. College,

SIR:—I hand you herewith report of Agricultural and Chemical Departments of this College for past two years.

Yours respectfully,
WM. C. STUBBS,
Professor of " Chemistry and
Acting Professor Agriculture."

REPORT.

On Monday morning, fourth day of July, 1881, Col. Wm. H. Chambers, professor of agriculture in the State Agricultural and Mechanical College died. The chair, which he had so ably filled, was thus suddenly vacated by the hand of death. The experiments which he had planted, and watched, with the liveliest interest, were left without a master to note their progress or record their results. Our "Board of Directors" had held their annual meeting and adjourned a few days before his death. To call them together again for the purpose of taking proper steps for securing an immediate successor, was deemed inexpedient. The Faculty met and determined to temporarily provide for his duties by apportioning them among themselves. To the writer was assigned the duty of supervising the farm with its varied crops and numerous experiments.

He now submits to the public a report of these crops, and the results of the experiments. The following were found on the farm: A vineyard of one half-acre; a bed of strawberries; a peach orchard; two acres in grasses and clover; two acres in peas; three and one-fourth acres in corn, and six acres in cotton.

VINEYARD.

The following varieties which are now in full bearing, and fairly productive, were found, viz: "Hartford Prolific," "Ives Seedling," "Concord," "Salem."

These vines were procurred several years since from the well-known nursery of C. C. Langdon, Langdon Station, near Mobile, Alabama.

The income from this vineyard this year was small owing to lack of facilities for marketing the grapes or making them into wine. It is highly probable, that hereafter under proper management, a considerable profit may be realized from sales both of grapes and wines. The vines have been recently pruned and cuttings have been furnished to several citizens in different parts of the State, they paying only for transportation. In addition a good nursery has been established, and the hope is entertained of being able to furnish, in a year or two, roots of all the leading varieties.

The tendency towards total prohibition of sale of alcoholic drinks (except such wine as may be made from grapes grown upon Alabama soil) as evinced by the several acts passed by our last Legislature, respecting certain counties, towns, beats, and neighborhoods, seems to be on the increase in our State. "The distilled liquors must give way to the fermented juice of the grapes, and that grape must be grown upon our own soil," is the voice of many of our best citizens, as well as tho opinion of our legislators. When we remember the adaptability of the grape to our soils, and its prolificness, as well as the ease of converting its juice into a really good wine, we can still see hope in the future for the wine bibber, and pride and pleasure in the husbanman, as he drinks a glass of "Cream Concord," or "White Scuppernong" of his own vintage to the health of his invited guest. In fact, considering the healthful influence of both grape and wine, it is surprising that every farmer is not supplied with a vineyard of sufficient size, to meet all home requirements.

The following crude method of making wine has succeeded admirably in our hands, and it may be of interest to some of our readers. The grapes are crushed in a hand mill (a simple cylinder with nails driven in it, revolving in a box, one of whose sides are slanting and contains also nails driven in it, and turned by a handle), and put at once in an open cask or barrel. If cream wine is desired, the clear juice is drawn off at once from hulls and pulps, and placed in a closed cask, with proper amount of sugar and water—the bung left out till fermentation ceases. If red wine is preferred, the juice is allowed to ferment on hulls for several days, stirring at intervals. When fermentation has completely extracted the juice, from hulls and seeds, the clear liquid is drawn off, put into a closed cask with proper quantities of sugar and water, and bung left open until all fermentation is over. Care should be taken to fill completely these closed casks. When fermentation is over the bung should be replaced, and contents remain undisturbed till winter, at which time the clear wine should be "racked" from the "lees" and placed in a another cask, filled and corked. The "racking" is easily done by a syphon tube without disturbing the lees at the bottom. After this, the wine may be drank "*ad libitum*," although it will increase in aroma and bouquet, if not in alcoholic strength, by age, and will also need another racking after the second fermentation, which will take place in the following spring "when the buds begin to burst in the vineyard."

The question may be asked how much sugar and water must be added to make a good wine from the different varieties of grapes?

Since grape-growing and wine-making are in some parts of the State an important industry, and since our native wines are commanding fair prices in New York, it was thought worth the trouble of instituting experiments to test this question. In the *American Wine and Grape Grower*, now before me, for December, 1881, southern wine from Concord, Ives, scuppernong, &c., is quoted at $1.00 to $2.00 per gallon, and demand greater than supply. There is no reason why a considerable revenue might not be realized from this industry, and there never was a more favorable time for enlarging it than the present, since the phylloxera, by their devastations, are fast reducing the annual yield of wine in France.

According to Dr. Gall, of France, a distinguished chemist, who devoted much time and study to this subject, a good wine should consist, in every 1000 pounds, of two hundred and forty pounds sugar, six pounds of tartaric acid, and seven hundred and fifty-four pounds water; or, expressing it in per centage:

Sugar	24.	per cent.
Tartaric acid	.6	" "
Water	75.4	" "

How far the must from our different varieties meets this requirement, the following experiments, made by the writer, will probably throw some light upon:

HARTFORD PROLIFIC.

The berries from this grape wore crushed in a hand-mill, and the clear juice (cream must) removed, at once, from hulls and pulps. This was analysed, and found to contain:

Acid	.412
Sugar	11. 75

Another quantity of berries were placed in a cider-press and the juice thoroughly removed by pressure from hulls and pulps. Three hours after it was analysed, and found to contain:

Acid	.75
Sugar	11.50

CONCORD.

The cream must obtained as with the Hartfords, and analysed at once, contained:

Acid	.425	per cent.
Sugar	14. 00	" "

Some berries gathered one day after were crushed and thrown into an open stand and filtered, juice analysed at intervals—one hour, three and a half hours, five hours, and sixteen hours—with following results:

	1 hour.	3½ hrs.	5 hrs.	16 hrs.
Acid......per cent.	.562	.75	.825	1.2
Sugar..... " "	14.50	14.00	13.00	11.00

Here we find, as was to be expected, that fermentation decreased the sugar by converting it into alcohol, and increased the acid bv releasing it from bulls and pulps. In the process of fermentation the hulls are thoroughly cleansed, and the pulps reduced to seed. The latter are cleaner than could possibly be done by artificial means. Another quantity was placed under a cider press on Wednesday, at 10½ a. m., and after turning the lever rather tight, left in this condition till Thursday, at 1½ p. m., when juice was expressed and analysed, with following result:

Acid	1.05 per cent.
Sugar	11.00 " "

Three open stands were filled with crushed berries at 11.30 a. m., on Wednesday, and the juice removed forty-eight hours after, on analysis, contained:

Acid.. 1.25 per cent.
Sugar (not determined).

Another quantity under press for same length of time gave—

Acid 1.2
Sugar (not determined.)

It is evident, from these experiments, that the cream wine from the Concord grape is not over rich in acid; but the red claret fermented on hulls must have its excess of acid neutralized bv addition of water, in order to bring it within standard of Dr. Gall. Both need sugar to reach the same standard.

IVES SEEDLING.

The cream must obtained as heretofore, gave immediately—

Acid..	.30 per cent.
Sugar..	13.00 " "

The same pressed, gave—

Acid..	.375 per cent.
Sugar..	13.00 " "

Crushed berries were thrown into open stands, and analysed at intervals of three hours, four hours, twenty hours and twenty-four hours from time of crushing. Result:

	3 hours.	4 hours.	20 hours.	24 hours.
Acid......per cent.	.487	.525	.9	.97
Sugar..... " "	13.	12.75	Not determined.	

These grapes—Halfords, Concords and Ives—belong to the Labrusca species and are, with us, the most productive, though not so rich in saccharine matter as those of the Æstivalis species. On this account, they will doubtless constitute the major-part of every vineyard in the South. An examination of the above will show that most of the acid in these grapes are so intimately connected with hulls and pulps, that nothing less than fermentation can remove it. They furnish cream wines of great excellence when proper amount of saccharine matter is added, but unless these red wines are properly handled, they are always sour and inferior. Correctly Gallised, they make, however, wines of great body and fine aroma. The average amount of sugar in this species may be placed at 13 per cent. without much error.

The cream must may be considered as having the proper amount of acid; but when fermented on hulls, we may assume the average amount of acid at about 1.1 per cent.

Analyses were also made of the juices from the following—all of the Æstivalis species (summer grapes):

ELSENBORO.

Acid	.8	per cent.
Sugar	17.00	" "

LOUISIANA.

Acid	1.05	per cent.
Sugar	19.00	" "

CYNTHIANA.

Acid	1.40	per cent.
Sugar	17.00	" "

LINCOLN.

Acid	1.10	per cent.
Sugar	20.50	" "

NEOSHO.

Acid	.7 per cent.
Sugar	19.25 “ “

ALVEY.

Acid	.80 per cent.
Sugar	19.00 per cent.

HERBEMONT.—(Warren.)

Acid	1.30 per cent.
Sugar	18.00 per cent.

CUNNINGHAM.

Acid	1.40 per cent.
Sugar	19.00 per cent.

HUGH.

Acid	1.40 per cent.
Sugar	17.50 per cent.

These analyses do not correctly represent these grapes, since some of them were riper than others, and to make a first class wine, the grapes should always be fully ripe—however, they show a much higher percentage of sugar, than those of Labrusca species. This was to be expected since ripening much later in the season they have more sunshine to elaborate sugar.

The following partial experiments were made upon the scuppernong grape. On September 3d, (berries not yet ripe) the juice contained .3 per cent. of acid. September 5th, .325 per cent. September 10th, .35 per cent, and on this day the sugar was also determined which was 13.75 pr. ct. All these were made upon the cream must. On September 11th, some berries were placed under the press, and after remaining several hours, the juice contained

Acid	.45 per cent.
Sugar	13.75 per cent.

September 12th, after a heavy rain, the juice treated in the same manner, yielded

Acid	.40 per cent.
Sugar	12.75 per cent.

The acid in scuppernong is low, and may be approximately placed at .4 per cent., Sugar 13 per cent. The wine from this grape easily undergoes acetous fermentation and hence great difficulty in keeping it for any length of time. An experiment was made to verify this assertion. The juice from this grape, after having passed through the most violent stages of first fermentation, was placed in a barrel and the latter filled to overflowing and the bung left out. One week after filling the barrel, the new wine contained .85 per cent. of acid. This was found upon further analysis to consist of .495 per cent. tartaric acid, and .375 per cent. acetic acid, (the acid of vinegar), hence this wine from scuppernong grape has to be handled with a great deal of care, to prevent its turning into vinegar.

In adding sugar to wine, a common error prevails, in simply adding to the percentage found enough to make the percentage 24—e. g., if the juice contains 10 per cent. sugar, 14 per cent. or 140 pounds of sugar are added to every one thousand pounds of juice. A close inspection will show the absurdity of such a hasty deduction. If to one thousand pounds of juice containing 10 per cent of sugar, we add one hundred and forty pounds sugar, we will have 1140 pounds juice containing two hundred and forty pounds sugar or a little over 21 per cent. The proper way to estimate amount of sugar required may be shown by following: One thousand pounds of juice containing 10 per cent. sugar, has nine hundred pounds water. Every seven hundred and fifty-four pounds water requires two hundred and forty pounds sugar, therefore we have the simple proportion 754 : 900 :: 240 : =284 pounds. But of 284 pounds required 100 is furnished in juice, therefore 184 pounds must be furnished for every 1000 pounds of juice. This is *theoretically* true, but pure *loaf* sugar, the kind usually used, contains about 10 per cent. of water and *only 90 per cent. sugar*, therefore a further correction is needed, which we make by following proportion 90 : 100 :: 184 : =204 pounds. This, then, is true amount of loaf sugar to be added to every 1000 pounds of juice which contains 10 per cent. sugar. The Labrusca species and the scuppernong contains about 12—13 per cent. of sugar—1000 pounds of juice from these grapes will measure about 100 gallons. One gallon will require about 1.6—1¾ pounds loaf sugar. The following table calculated for my own use will doubtless be found useful to some of my readers.

Per cent. of Sugar in Juice.	Pounds of sugar req'red to make 24 per cent.	Amount of sugar in juice.	Total sugar to be added.	Loaf Sugar to be added, only 90 % Sugar.
10 per cent......	284 pounds.	100 pounds.	184 pounds.	204 pounds.
11 per cent......	281 "	110 "	171 "	190 "
12 per cent	278 "	120 "	158 "	175 "
13 per cent......	275 "	130 "	145 "	161 "
14 per cent......	272 "	140 "	132 "	147 "
15 per cent......	269 "	150 "	119 "	132 "
16 per cent.. ...	265 "	160 "	105 "	117 "
17 per cent......	262 "	170 "	92 "	102 "
18 per cent.. ..	259 "	180 "	79 "	87 "
19 per cent......	256 "	190 "	66 "	73 "
20 per cent	253 "	200 "	53 "	59 "

Before closing this subject, it must be borne in mind that the percentage of sugar in same grape varies within certain limits in different years, the highest amount being produced in dry years, and lowest in wet. Again, picking the grape directly after a rain will sensibly diminish the percentage of sugar. Another fact worthy of note here is that every 2 per cent. sugar makes 1 per cent. alcohol and therefore the normal or standard wine, contains 12 per cent. of alcohol.

STRAWBERRIES.

The bed consisted of Wilson's Albany and one other variety name not known but thought to be Charles Downing. No record has been found of them and since they ripened before, I took charge of the farm, I can do no more than merely to mention them.

PEACH ORCHARD.

A vigorous young peach orchard now over three years old occupies the North-West corner of the farm. They are nearly all of the early varieties and are now in a flourishing condition and promise a good bearing the ensuing year.

COW PEAS.

No crop is more universally grown at the South than our field pea, and none about which less is known. Heretofore but little interest was manifested in it beyond the raising of a few bushels by every farmer from Maryland to Texas. Recently it has received some scientific investigation both in regard to its botanical relations and its chemical composition. It is not in reality a pea, but a bean, and belongs to the genus "Dolichos." We give below an extract from an able paper upon "The Southern Pea" from pen of Prof. J. P. Stelle, Agricultural Editor of Mobile Register. The genus is divided into quite a large number of species, four of which, now in general cultivation, are usually thrown together under the common name of Southern Field-pea. They are,

THE COW-PEA

known to botanists as *Dolichos unguiculatus.* In this species are many prominent varieties, as the Red Cow-pea, the White Cow-pea, the Black-eyed Pea, and so on. So conspicuous is this species that in some localities it is made to carry the name of all the others, all being referred to for common as simply the Cow-pea.

THE WHIPPOORWILL-PEA

(*Dolichos antrostomus*), so named because the seed resembles the egg of the whippoorwill in color and markings, seems to have no strongly indicated varieties, but is one of our best peas and most popular, on account of the fact that it is supposed to succeed better on extremely poor land than any of the other kinds.

THE BLACK CORNFIELD-PEA

(*Dolichos lablab*), an extensive runner, with heavy vines and jet-black seeds. Said to be one of our best peas for forage and for green manure. Has no sharply-marked varieties that we have seen.

THE CROWDER-PEA

(*Dolichos coarto*), a large round pea, thickly packed together in the pod; hence the name. There are many varieties, as the White Crowder, the Red Crowder, the Speckled Crowder and the Black-Eyed Crowder. The White Crowder is highly esteemed for table use, owing to the fact that it cooks easily and does not turn black and blacken everything cooked with it, as do most of the other kinds. It is not so long a runner as either of the other species, though it is a quite a heavy bearer.

The Cow-pea species of the field-pea is said to have been introduced from the American tropics, while the Black Cornfield-pea is believed to have been brought from Egypt. The native place of the other species is not known positively, some writers contending that they reached us from the East Indies, and other writers that they came from China. None of the species seem disposed to mix even when they are planted together in the same field.

Dr. A. R. Ledoux former director of North Carolina Experimental Station has analysed both the "Black" and "Yellow" Pea and their vines, with following results.

	Black Pea. (Fresh.)	Yellow Pea. (Fresh.)	Vines, Equal Parts of Each (Fresh.)
Moisture	20.85 per cent	19.20 per cent	72.81 per cent
Ash	2.94 per cent	3.31 per cent	2.00 per cent
Albuminoids	20.08 per cent	23.02 per cent	1.85 per cent
Cellulose	4.34 per cent	5.03 per cent	15.27 per cent
Carbohydrates	50.51 per cent	48.07 per cent	7.86 per cent
Fat	1.28 per cent	1.37 per cent	.21 per cent

REDUCED TO DRY STATE WE HAVE

	Black. (Dry).	Yellow. (Dry)	Vines. (Dry).
Ash	3.72 per cent	4.10 per cent	7.37 per cent
Albuminoids	25.37 per cent	28.50 per cent	6.81 per cent
Cellulose	5.48 per cent	6.23 per cent	56.27 por cent
Carbohydrates	63.81 per cent	59.49 per cent	28.88 per cent
Fat	1.62 per cent	1.68 per cent	.78 per cent

THE ASH CONSISTS OF

Potash	14.80 per cent.
Soda	23.29 per cent.
Magnesia	6.74 per cent.
Lime	22.57 per cent.
Phosphoric acid	9.28 per cent.
Sulphuric acid	2.35 per cent.
Silica	1.08 per cent.
Carbonic acid	19.70 per cent.
Chlorine	.19 per cent.

The above analyses simply corroborates what has been long known to the growers and consumers of this legume. It is a most excellent food, rich in nitrogenous matter. The white varieties are highly prized on the table of the rich—while all sorts are eaten and enjoyed by the poor. At some day, when the South becomes densely populated with a working class, it is destined to occupy the same place in the daily ration, as rice does now in China and Japan. Its highly nutritive value, the ease of cultivation, the rapidity with which it matures, and its capacity to yield fair crops upon poor soils, all point to it as the coming food for the toiling millions, which one day will occupy our Southern soil. It is excellent for stock food, and especially recommended for milch cows. Its vines too, when well cured makes an excellent hay or when turned under, or allowed to decay on surface, add largely to the fertility of the soil. It is sometimes called the "Clover of the South." It is used largely as a green manure by the sugar planters of Louisiana. Some varieties of cow pea are admirably adapted for restoring humus to our worn out cotton lands, and why they are not oftener used is a question often asked. The varieties of this genus offered on the market are very numerous, every size, shape and color being represented. Each neighborhood has its local pea, with its local name. Twenty-six different varieties have been secured for Agricultural Museum of this College. It is claimed for some of these varieties the power of remaining in soil all the winter without decaying, so that if sown with wheat in the fall they will remain dormant, until after wheat is harvested and then spring up and cover the ground furnishing a large crop of vines to be turned under in late summer.

It is feared by many, that this crop can never become an article of large traffic since the least warmth of spring or summer develops the weavil which soon destroy the pea. When kept at home, it should never be pulled till needed for use, and when shipped, should be done so in winter to prevent development of the weavil by warmth, "in transitu." It is a troublesome crop to pick and therefore many acres are left to be gathered by stock, often to the detriment of the latter.

It is surprising we do not cultivate it more largely, since we can with ease, grow it between the gathering of one crop of small grain and the seeding of another as following experiment shows.

Two acres were planted in oats in fall of 1880; the oats were gathered in spring of 1881, and the ground immediately sowed in speckled peas. From these two acres we gathered three thousand three hundred and twenty-one pounds of peas, which were sold as they were picked at one dollar per hundred. The cost of picking was twenty cents per hundred. After picking this quantity, the vines were "turned in" with turning plows. The cost of these two acres were as follows:

3 bushels peas sowed	@$1 00	$3 00.
2 days work plowing in	@ 1 50	3 00.
Picking 3321 pounds	@ 20	6 64.
Total cost		$12 64.

Credited by 3321 lbs. @ 100 per hundred..$	33 21.
Nett profit for two acres..........................	20 57.

This profit arose between the harvesting of a crop of oats and the seeding of another, to say nothing of improved condition of land by turning in the vines.

GRASSSES—IN 1884.

The following grasses were sown in the fall of 1880 and spring of 1881. Orchard, Blue, Red Top, and Tall medow oat. Near these were sown Lucerne and Red Clover at same time. Lucerne partially resisted the continuous drouth of last summer, but all the others mentioned, succumbed, save now and there a spire of "red top," which secured its immunity from death, by trenching itself close beside the ditch bank. Good stands of them all were secured, but all perished except Lucerne and red top.

BEGGAR LICE.

Besides the above, there was a small lot of one-eighth of an acre of beggar lice, "*desmodium molle*," in a flourishing condition, this being the second year it has occupied the ground. This plant analysed well, as will be seen from the below, taken from Agricultural Report of U. S. for 1878.

Fats..	2.79 per cent.
Carbohydrates..............................	43.04 per cent.
Cellulose..........................	25.39 per cent.
Albumenoids................................	21.22 per cent.
Ash..	7.56 per cent.

It is eagerly and even greedily eaten by stock and fowls of all kinds, and I can see no reason why it might not be made to occupy much of our surplus lands, and yield a handsome profit either as a forage plant, or by turning it under to enrich the soil.

PRICKLEY COMFREY.

I found also, about one dozen stalks of Prickley Comfrey (*symphitum asperrimum*), which are now about four years old. No attempt has been made by me to utilize these plants beyond tempting several animals to eat their leaves. The latter were pulled and offered in their green state to several cows and horses. Only one or two ate them, and they with marked hesitation. I append below analysis of Prof. Vollcker of this plant.

		Calculated dry.
Water	90.66	
Fats	.20	2.20
Albuminoids	2.72	29.12
Carbohydrates	1.28	13.65
Cellulose	4.30	35.43
Ash	1.75	19.60

From above we see that Albuminoids are far in excess of carbohydrates being in proportion of over two to one. An unusually large amount of ash is present. It is a very hardy plant, and as it may be cut many times during the year, it may have a place in the economy of cattle feeding.

GRASSES IN 1882.

Another unsuccessful attempt was made to grow grasses during the present year. Small plats, equal in size, highly manured with stable manure, deeply spaded in, and then top dressed with Alabama fertilizer, were prepared and planted on the 8th of March, as follows:

No. of Plat.	Common Name.	Botanical Name.	Stand.
1	Red Clover	Trifolium Pratense	Good.
2	White Clover	Trifolium Repens	Good.
3	Scarlet Clover	Trifolium Incarnatum	Excellent.
4	Alsike Clover	Trifolium Hybridum	Excellent.
5	Lucerne	Medicago Sativa	Good.
6	Trefoil	Medicago Lupulina	Poor.
7	Vetch	Vicia Sativa	Poor.
8	Sainfoin	Onobrychis Sativa	None.
9	Florida Clover	Richardsonia Scabra	Good.
10	White Lupins	Lupinus Albus	Poor.
11	Timothy Grass	Phleum Pratense	Poor.
12	Red Top Grass	Agrostis Vulgaris	Poor.
13	Orchard Grass	Dactylis Glomerata	Good.
14	Perennial Rye Grass	Lolium Perenne	Excellent.
15	Sweet-scented Vernal	Anthoxantum Ordoratum	Poor.
16	Blue Grass	Poa Pratense	Poor.
17	Canary Grass	Phalaris Canariensis	Good.
18	Hungarian Grass	Panicum Hungariensis	Good.
19	German Millet	Panicum Germanicum	Poor.
20	Hemp	Cannabis Sativa	None.
21	Flax	Linium Usitatissimum	Good.
22	Maw	Papaver Rhoeas	None.
23	Colza	Brassica Campestris	Good.

The sainfoin, hemp and maw, did not germinate at all. Of the others we obtained stands varying from "poor" to "excellent." The Florida clover survives with great luxuriance of growth and completely covers the ground. It seems to be enjoyed by both horse and cow. The seed of this plant was obtained from Mr. John M. McGehee, of Milton, Florida, at the Atlanta Exposition. It is a native of Mexico and South America, and has become extensively naturalized in many parts of the State. It is a rapid grower, with succulent, spreading, leafy stems, and small white flowers in heads or clusters at the end of branches and in axils of leaves. It is receiving some notoriety as a soiling crop, and is scarcely inferior to clover in nutritive value. (Dr. Mohr.)

The following analysis is taken from Agricultural Report for 1869, Washington, D. C.

Water	6.34	per cent.
Ash	7.82	" "
Fat	2.89	" "
Cellulose	27.97	" "
Albummoids	5.60	" "
Carbo-hydrates	49.38	" "

A small quantity of lucerne can be see at present struggling through the dense crab grass, induced by the heavy rains of summer. Of the cloves not one survived the drouth of May and June.

The orchard, canary and Hungarian grasses ripened their seed and died. On 1st May the plat of "Perennial Rye Grass" presented a lovely appearance. It was about six inches high, densely crowded and very green—a perfect sward. After the continuance of the drouth far into May it lost its verdancy and assumed the sere and yellow leaf of death. The German millet, flax and colza matured and bore good crops.

In addition to above a few acres of Johnson's grass, "Sorghum halapeuse," was seeded in spring with seed obtained from Mr. Hebert Post, Marion Junction, Dallas county, Alabama. Only a tolerable stand was obtained, which has been cut twice during the season. It is spreading rapidly and we have a promise of early occupancy of entire ground. This grass is cultivated to a very large extent in many parts of the South. It is enthusiastically praised by some and condemned by others. No agricultural crop has been the subject of such fierce discussions as this, and since so little is known of it, it has been deemed advisable to insert here a short history, with its characteristics and habits of growth. Capt. Means, of Charleston, South Carolina, brought the seed from Egypt a few years before the war and scattered in his garden. It took his garden and surrounding fields. Stock ate it greedily. In 1860, Capt. Johnson, of Marion Station, Alabama, visited this country and hearing of this grass, (which had now gained a great reputation) secured a bushel of seed and brought them to Alabama. In passing Columbiana, in Shelby county, he gave a part of them to a friend, who planted them there—the rest he took home with him and sowed on his plantation. From these nuclei, it has spread over the South. It is a true sorghum and called in its native habitat, on the banks of the Nile, Egyptian sugar cane. Here it grows fifteen–twenty feet high, filling completely the upper Nile, furnishing chief sustenance to the cattle of that country. It is tender and sweet when young, and full of sugar. When cut before it is too old it makes excellent hay, as the following analysis will show:

Fats	2.86.
Ash	4.85.
Albuminoids	13.18.
Carbo-hydrates	53.96.
Cellulose	25.15.

It gives an early pasture and upon rich bottom lands it yields an excellent hay—often affording four cuttings a year of one ton per acre each time. It thrives on rich bottom land, though it will afford good pasturage upon poorest uplands. It is killed to ground at first frost, but reappears with first warm days of spring. It spreads both from seed and from its creeping rootstocks, and hence, can be propagated from either.

These are its virtues. Its only vice is its tenacity of life, overcoming every effort looking to its eradication, and its tendency to spread, thoroughly entrenching itself with each advance. So, care must be taken to plant it just where it is wanted forever. It is said that the continuous breaking up the roots in winter with a turn plow, and allowing hogs to feed upon them, is a most effective way of destroying it. Every one who is growing it, praises it. It would be well, however, to test it thoroughly on a small scale before giving your entire plantation to it.

Recent experiments made at Royal Agricultural College, in England, with different kind of fertilizers upon grasses, gave following conclusions:

First—The effects of nitrate of soda and of sulphate of ammonia, were equal and surpassed all the other manures used.

Second—Superphosphates gave better results than ground mineral phosphates.

Third—Lime, both as quicklime and gypsum, very largely increased the yield of grass over the produce of the unmannured plots.

POTATOES.

With a view of determining the best manure adapted to Irish potatoes, the following partial experiments were made:

Eleven rows, ninety feet long, two feet wide, were laid off and planted with the Early Rose variety, and the following manures used:

No. 1—Nothing.
No. 2—One pound nitrate soda.
No. 3 { One pound nitrate soda.
" " super-phosphate.
" " muriate potash.
No. 4 { One pound super-phosphate.
" " muriate potash.
No. 5—One pound muriate potash.
No. 6—Nothing.
No. 7—Two pounds cotton seed meal.
No. 8 { Two pounds cotton seed meal.
One " super-phosphate.
" " muriate potash.
No. 9 { One pound super-phosphate.
" " muriate potash.
No. 10—One pound muriate potash.
No. 11—Nothing.

From the start those manured with nitrogenous fertilizers, did the best both in size and quantity of tops and tubers.

They were planted in February and early in April we began to eat them. We could see no difference between those of numbers five and six. In fact, cotton seed meal, especially with super-phosphate, upon this soil, seemed to answer all the requirements of this plant.

But conclusions drawn from experiments upon potatoes in *our* soil and climate cannot be used with impunity upon another. No plant better illustrates the effects of soil and climate upon its growth and quality, than the Irish potato; occurring native in the deep valleys and canyons of the Eastern Rocky Mountains, from Colorado through Mexico, and into the higher mountains of South America, it is nowhere found with *large* tubers. Tubers the size of acorns, of all colors and shapes, only, are found.

Its white flowers and small leaves, sufficiently indicate the plant. The valleys where they are found are from five thousand to eight thousand feet above sea-level—always cool—sometimes *cold*—very dry—sometimes so dry that plants remain dormant for years, and then spring into a renewed vigor at the coming of rain.

Cultivation so changed the habits of this plant, that the improved varieties, it is said, will not grow in the same soil in which wild ones *thrive*, while even several thousand feet above, the improved sorts grow to a large size, and excellent quality.

Many botanists think, from this, that these wild tubers have, in time, been washed down from a higher and more congenial soil and clime to one where they can maintain an existence only.

It is now well known to the cattle men of this country that the cultivated varieties cannot always be made to succeed where wild ones are found growing.

The results of our experiments so fully agree with those recently made by Mr. Russell Swanwick, Cirencester, England, under direction of Dr. E. W. Prevost, professor of chemistry in Royal Agricultural College, that we cannot refrain from giving a short notice of them:

His plot without manure produced seven tons and four hundred pounds per acre. Farm yard manure yielded ten tons and two hundred pounds. There were twelve other plots—seven of which contained sulphate of ammonia, and all of these exceeded in yield that of stable manure. The largest yield and profit—twelve tons and twelve hundred pounds per acre—was from application of superphosphate and sulphate ammonia. "This, remarks Mr. Swanwick," "looks as if some form of nitrogen, ready for immediate use by the plant, were necessary for its *early* growth, and a more slowly-decomposing form of nitrogen, necessary to carry on the *later* growth. Sulphate ammonia is seen throughout to have had a remarkable effect, especially, when in conjunction with a soluble phosphate."

In our experiments we found nearly similar results. Cotton seed meal effecting for us what the sulphate ammonia did for Mr. Swanwick.

The growing of early potatoes for market in our State, has become a considerable business, and is on the increase—hence we give above experiments, by way of a few suggestions, to pioneers of this laudable enterprise.

We also append the following remarks of Dr. Lewis E. Sturdervant (Director of New York Experimental Station) before the Farmer's Club of Elmira, New York. Some of my experiments with potatoes have already given interesting results:

"Take a potato, he says, peel it heavily, and plant the peeled potato in dry soil. The shoots will grow. This shows that the potato shoots penetrate further into the potato than we have generally believed. Now plant potato peelings. We observe that the plant is feeble in early growth, and late in formation of tuber. Now plant large, flat pieces of potato. We observe at date a good growth, a moderate formation of tubers.

Now plant single eyes cut deeply. We observe that these form vigorous plants, and early and prolific tuber formation. Plant now potato shoots laid in the row; we observe very early formation of potato and prolificacy, with moderate leaf growth. What do these facts indicate? This, that the *depth* of the cutting of the eye has more influence on the crop than the size of the seed. In like manner, as we investigate the potato crop, we see marked indications — at date, for we are not reporting results, but progress—that single eyes, cut deeply, are superior for seed in every respect to pieces of potato or whole potatoes; that the deeper the cut the better and earlier the crop, and hence that large potatoes, if preferable for seed, probably derive their advantage from the eyes being deeper than are the eyes from small potatoes, for long sprouts give us earlier potato formation than short sprouts, and the eyes have certain analogical resemblance to the shoots which they originate."

EXPERIMENTS IN WHEAT.

In October a bushel of each "Bill Dallas" wheat and "Sparks Swamp" wheat was received from the Agricultural Department at Washington.

Of the "Bill Dallas" Messrs. Mark W. Johnson & Co., of Atlanta, Georgia, says: "After thoroughly testing the variety usually known as the "Bill Dallas Rust Proof Wheat," we unhesitatingly pronounce it the surest cropper yet originated—having lost only one crop in ten years, and that from the fly or some insect, not rust. We have never known it *to rust.* It is classed by millers as between a white and amber wheat, yielding first-class flour. It appears to be a hybrid—a smooth-bearded wheat with almost invariably some bearded-heads cropping out amongst it. The crop just harvested shows the largest yield of any variety in this section—the yields so far reported being from twenty-one and a half to thirty bushels per acre."

Hon. J. T. Henderson, Commissioner of Agriculture of Georgia, says: "The Dallas wheat, originated some fifteen years since in Edgecomb county, South Carolina, whence it was introduced into Georgia, by William Sims and William Dallas, two prominent farmers of Lincoln county. It has long been a favorite in that and adjoining counties, and has found its way to a few localities in other parts of the State. The reports of those who have sown it indicate beyond doubt that it is an unusually hardy wheat and capable of resisting the attack of rust under any ordinary circumstances, and of yielding a fair return of good wheat when other and sometimes favorite varieties have been utterly ruined by this fungus."

With such recommendations we expected great results, and hence took great pains in proper preparation of the ground, seeding, and manuring.

The Spark's Swamp wheat is a red-bearded variety and very similar to the Mediteranean, both in appearance and habits of growth. It too *had* high recommendations, and we had hopes also of its success.

Two acres were thoroughly prepared and on each, sixty bushels of compost, consisting of equal parts of cotton seed and stable manure were evenly spread, and the seed sown at rates of one bushel per acre, on November 12th, 1881. Both came up prettily and made a fine growth during the mild winter. In February each acre was top-dressed with one hundered pounds dissolved bone (fourteen per cent. of soluble phosphoric acid). In the latter part of February, the Spark's Swamp wheat began to rust, and for several weeks we did not think it would ever mature. It rallied greatly in April and presented a fair appearance in May. The Dallas continued to grow and do well till last of April when it was also attacked by the rust, which was however mainly confined to the stem. It headed out in May and gave promise then of a fine crop, despite the rust. In latter part of May both were cut with a reaper and carefully housed. They were threshed July 8th, with the following results:

Bill Dallas wheat, ten and one-half bushels.
Spark's Swamp wheat, five and one-fourth bushels.

The yield of straw was much larger with the Bill Dallas than with the Spark's Swamp wheat. The Dallas has been reserved for future seed and will be again experimented with the present year. The Sparks was condemned as unworthy of further trial.

OATS.

A bushel of Gain's Winter Oats was also received from the Agricultural Department at the same time.

An acre was prepared at the same time and in the same manner as those described for wheat. It was also seeded at the same time. It came up quickly, and made an excellent stand, but spent the entire fall and winter in tillering. Late in the spring when the Texas Rust Proof, sown by the side of it, and treated in the same way was fairly headed out, this variety had scarcely left the ground. It rusted so badly and was so late in maturing that it was on June 3rd, cut when in bloom and converted into hay.

Our great enemies here to small grain are rust and drouths just at time the full development of heads is taking place. " A dry May for a good crop " is a proverb among cotton planters. This is true, in that it enables the farmer to chop out his cotton and put it in excellent condition for growing, but it is true in no other sense, and always detrimental to grain and grass crops, particularly small grain which is, during this month in our latitude, developing only the grain.

To escape rust we must have early ripening varieties. To secure which our seed must come from the south of us with the habits of short seasons and rapid growth fully impressed upon them. No small grain grown at the North can be relied on here until it is thoroughly acclimated. There, it is custom to plant in September and October, and reap in June and July. When imported to South, it aims to preserve the same habits and hence is subjected to attacks of rust and drouths, the latter nearly always prevalent during May and June. The reverse of this is true with corn. Northern varieties make small growth, mature early, giving poor yields. We think we can assert that our small grain should come from South, and our corn from North when early maturity is desired.

CORN IN 1881.

EXPERIMENT FIRST.

Two acres accurately measured were manured with sixty bushels cotton seed, broadcast, and turned in with turning-plows. After breaking up the land, a mixture of two hundred pounds cotton seed meal and two hundred pounds dissolved bones was applied to each acre, and corn planted. Implements used in cultivation: cultivator, Dixie plow, with small mould-board and hiller. Results: five hundred pounds fodder and 43.2 bushels corn.

The cost of manure on two acres	$17 50
The cost of working two acres	15 00
The cost of gathering two acres	2 00
Total cost	$34 50

Value of products:

500 pounds fodder, at $1.00	$ 5 00
43.2 bushels corn, at $1.00	43 20
Total value	$48 20

The season was unusually dry, and the corn suffered heavily. Such land with above manuring ought to have produced seventy-five to eighty bushels.

EXPERIMENT SECOND.

One acre, turned over before planting, received a mixture of two hundred pounds cotton seed meal and two hundred pounds dissolved bones. Corn planted, and plat divided into two equal parts—(*a*) receiving one hundred pounds superphosphate, and (*b*) one hundred pounds cotton seed meal and two bushels leached ashes.

Results of (*a*)— { 170 pounds fodder.
10.29 bushels corn.

Results of (*b*)— { 178 pounds fodder.
12.34 bushels corn.

Here, too, the long drouth seriously affected the ultimate results.

EXPERIMENT THIRD.

This experiment was made for purpose of testing the theory of root pruning.

One-fourth of an acre, manured after turning, with a mixture of fifty pounds cotton seed meal and fifty pounds dissolved bones, was planted in corn, and plat divided into equal parts—(*a*) deeply and closely plowed throughout season with a subsoil plow, and (*b*) shallow cultivation, with hiller.

Results: (*a*)— { 50 pounds fodder.
2.64 bushels corn.

(*b*)— { 44 pounds fodder.
1.8 bushels corn.

The results of these experiments seem to be in favor of "root pruning," and they are more remarkable when we consider that this root pruning continued through the long drouth which prevailed during the month of June. Dr. Lewis Sturdevant, of Wauskaukum farm in Massachusetts, is a leading advocate of root pruning, and claims a largely increased yield by this method over the usual mode of cultivation. The above experiments, while rather supporting his theory, by no means prove it; and we shall require many others with similar results, before we will announce our faith in deep and close plowing of corn during our long and dry summers.

EXPERIMENTS IN CORN FOR 1882.

These experiments were instituted to determine the power of corn for gathering its supplies of food from soil and air, and the effects of different ingredients of plant food upon its growth. Different kinds of plants have different capacities for making use of supply of food that soil and air contain. Leguminous crops like clover, cow-peas, &c., in some way gather a large amount of nitrogen, where cereals such as wheat, oats, rye, &c., would half starve for the lack of it, and this, too, in spite of the fact that leguminous plants contain a great deal of nitrogen, and cereals relatively little. Hence, a heavy nitrogenous manuring may pay well for wheat, &c., and be lost in part on clover, peas, &c.

Ville has classified plants according to the predominant ingredient needed by that plant in its manures. He calls wheat, barley, rye, oats, &c., nitrogenous plants; peas, beans, clover, Lucern, potatoes, &c., potash plants; turnips, radishes, Indian corn, sugarcane, &c., phosphoric acid plants.

From Ville, we should say that corn needed large quantities of phosphoric acid.

Mr. Lawes has found that cereals have been most helped by nitrogen, next by phosphoric acid, and only a little by potash. The legumes have responded to mineral manures, especially potash, and paid but little attention to nitrogenous manures. Turnips have done best on superphosphates, and pototoes have demanded potash, along with nitrogen and phosphates, for their best development. He classifies corn along with the cereals as a nitrogen plant; and in a letter to a leading farmer of this country he says: "It is of very great importance to know to what extent Indian corn follows the law of cereals."

Mr. Harris, in his book "Talks on Manures," says we know less about manurial requirements of corn than almost any other crop we cultivate. Mr. Harris is inclined to class it with cereals, but mentions some facts which would indicate that its feeding capacities are more like those of the legumes. Mr. Lawes, while classifying it with cereals, expects that with mineral fertilizers it would, during its longer period of growth, get more nitrogen from the soil, especially since its growth is continued through that period of year when nitrification is greatest. Formulas for corn have been given by leading scientific men, varying largely both in cost and in quantities of leading ingredients.

It is evident that men who ought to be well fitted to judge differ very widely in their views upon these most important subjects, and that nothing but actual experiment will bring us the certain knowledge that is needed. The above remarks are abridged from a "Report on Experiments" by Professor W. O.

Atwater in 1878 and 1879 to Connecticut Board of Agriculture. It was through his influence that these experiments were undertaken not only here, but in nearly every State in the union, by private farmers and agricultural colleges. Results of these experiments, though often discordant, are published yearly for benefit of farmers. A very poor piece of sandy land was selected for experiment. It is believed that no manure of any kind has ever been used on this land—certainly none in the last ten years. Plats of one-fortieth of an acre were accurately laid off in rows five feet three inches apart. The manure was put out on 20th and 23d, no rain intervening, and corn planted on 23d, three feet apart in drill.

The nitrate of soda used	contained	16	per	cent.	nitrogen.
" superphosphate "	"	16	"	"	phosphor. acid.
" muriatic potash "	"	50	"	"	potash.
" sulphate ammonia	"	11	"	"	nitrogen.
" dried blood used	"	11	"	"	nitrogen.

CULTIVATION.

May 1st, 1882, with Dixie plow, small mould-board.
May 11th, 1882, with Ross horse-hoe.
May 24th, 1882, with hoes.
May 28th, 1882, with Dixie plow, small mould-board.
June 9th, 1882, with horse-hoe.
June 21st, 1882, with horse-hoe; *laid by.*

EXPERIMENTS IN CORN—1882.

One-fortieth of an acre to each experiment—Manures broadcasted.

No. of Experiment.	No. of printed label.		Yield.		Yield per acre.	
			Corn lbs.	Stover lbs.	Corn lbs.	Stover lbs.
1	0	Nothing	9	6	360	240
2	1	3¾ lbs Nitrate Soda	9¼	7¼	370	290
3	2	7½ lbs Superphosphate	14¾	10½	590	420
4	3	3¾ lbs Muriate Potash	10¼	8	410	320
5	4	11¼ lbs (3¾ Nitrate Soda, 7½ Superphosphate)	20	8	800	320
6	5	7½ lbs (3¾ Nitrate Soda, 3¾ Muriate Potash)	7	7	280	280
7	6	11¼ lbs (3¾ Muriate Potash, 7½ Superphosphate) mixed minerals	5½	9¼	620	370
8	7	15 lbs (11¼ Mixed Minerals, 3¾ Nitrate Soda)	19	11	760	440
9	8	18¾ lbs (11¼ Mixed Minerals, 7½ Nitrate Soda)	24½	10½	980	420
10	9	22½ lbs (11¼ Mixed Minerals, 11¼ Nitrate Soda)	23	9	920	360
11	6a	11¼ lbs Mixed Minerals	14½	10½	580	420
12	10	14 1–16 lbs (11¼ Mixed Minerals, 2 13–16 Sulphate Ammonia)	30	16	1200	640
13	11	16⅞ lbs (11¼ Mixed Minerals, 5⅝ Sulphate Ammonia)	39¼	15¾	1570	630
14	12	19 11–16 lbs (11¼ Mixed Minerals, 8 7–16 Sulphate Ammonia)	41	24	1640	960
15	6b	11¼ lbs Mixed Minerals	21	9	840	360
16	13	16⅞ lbs (11¼ Mixed Minerals, 5⅝ Dried Blood)	33	17¼	1320	690
17	14	22½ lbs (11¼ Mixed Minerals, 11¼ Dried Blood)	45	21	1800	840
18	15	28⅛ lbs (11¼ Mixed Minerals, 16⅞ Dried Blood)	35	20¼	1400	810
19	6c	11¼ lbs Mixed Minerals	21½	11¼	860	450
20	00	Nothing	6	7¾	240	310

By corn, we mean the "slip-shuck ears."
By stover, we mean fodder, stalks and outer shuck.
The slip shuck ear weighed seventy-four pounds to the bushel of corn.

The heavy rains which soon followed the planting of this corn appeared to have washed beyond the reach of the roots of the young corn much of the nitrate of soda, as at no time during its growth could we see that marked difference between those plants manured with this chemical and those upon which no manure was used, as was the case in every instance where sulphate-ammonia and dried blood were used. It has long been known that nitrate-soda is exceedingly liable to be washed out of soils—particularly in sandy soils—and should always be used in the South with great care in the early spring, on account of unusual amount of rainfall at this time. Later it may be used with more safety.

From the above experiments we see that both phosphoric acid and nitrogen played important parts.

After a careful examination of all the experiments so far reported upon by Prof. Atwater, we think the discordant results can be easily explained. In soils, filled with inert nitrogen, in good cultivation and condition, the process of *nitrification* is constantly going on. Nitrification consists in the conversion of nitrogenous compounds into *nitric acid.* The necessary conditions are: 1st. organic matter containing nitrogen · 2nd, aeration—as oxygen of air is indispensable; 3d, the presence of a mild alkali as a carbonate e. g. lime; 4th, certain degrees of moisture and warmth. These conditions have been long known, but the manner in which nitrification was affected was pointed out in a paper to French Academy of Science only a few years since by the two eminent chemists, Schlossing and Muntz. These investigators found that nitrification of vegetable soils is due to "presence and work of a living principle—a vegetable germ—a ferment analogous to vinegar germ—that increased by fructification and multiplication of itself, that can be isolated and distinguished under the microscope by its shape, size, and characteristic appearance," and is called by them the "nitric ferment." This germ can be destroyed like other germs. Chloroform, deprivation of oxygen, heat of boiling water, all destroy it. Excessive humidity prevents its multiplication. Hence, necessity of underdraining. This nitric ferment flourishes best in an earth rich in vegetable matter and no soil can be fertile without it.

Messrs. Th. Schlossing and A. Muntz, in a more recent paper, give results of their investigations upon the condition that influence the production of nitrates, and thinking it may be interest to many of our readers, we here reproduce it from Comptes Rendus, vol. LXXXIX, pages 1,074-77:

RESEARCHES IN NITRIFICATION.

BY TH. SCHLOESSING AND A. MUNTZ.

Comptes Rendus, Dec. 22, 1879.

In this portion of our work, we propose to investigate the conditions that influence the production of nitrates.

Nitrification, like all reactions that accompany the development or life of organized beings, is accomplished within definite limits of temperature. Below forty-one degrees F, it is excessively feeble, if not entirely null. It becomes appreciable towards fifty-four degrees F. As the temperature is raised above this point, the quantities of nitrate formed are rapidly increased. At ninety-eight degrees F, the maximum is reached; the formation of the nitrate becomes very abundant, and, at this temperature, phenomena can be observed that would otherwise require months, or even years, to be appreciable. In going above ninety-eight degrees F, there is a rapid diminution. At one hundred and thirteen degrees F, less nitrate is formed than at fity-nine degrees F. At one hundred and twenty-three degrees F, very trifling quantities are obtained. Above one hundred and thirty-one degrees F, there is no longer a trace of it. All things being equal, in other respects, one can obtain under suitable conditions ten times more nitrate at ninety-eight degrees F, than at fifty-nine degrees F. Temperature, then, is a factor of the utmost importance in the production of nitrates.

Access of oxygen is, as is well known, an essential condition, which is, moreover, fully realized in the natural nitre beds. In fact, in soils which are in good condition, a superabundance of air is always found circulating through the pores and interstices. Such is not the case with liquids, in which the air, obliged to enter by the open surface, diffuses itself but slowly if the liquids are in a state of repose. Hence, other conditions being the same, the amount of nitrates formed is in direct proportion to the superficial extent of the liquid. In deep liquids the action of the organism may be promoted by forcing air into them.

It is well known that a certain degree of moisture is indispensable to nitrification. We have before remarked that desiccation in the air has the general effect to kill the nitric ferment. In all cases it absolutely arrests the action of the ferment so long as the desiccation continues. Confining the statement to solid mediums it is certain that nitrification is so much the more active as the degrees of humidity is greater; provided, nevertheless, that the medium be not swamped, and that the air can circulate freely among its particles; when that point is exceeded, nitrification is relaxed, or completely arrested.

A weak alkalinity in the medium is necessary to the production of nitre. In the natural condition it is generally the bicarbonate of lime, that performs the office of alkali. Very dilute alkaline carbonates produce the same result. But when their degree of concentration exceeds two or three thousands they become unfavorable to, or even arrest entirely the action of the nitric ferment. It is the same with the carbonate of ammonia as with the carbonate of lime. This explains the absence of the formation of nitre in the well known experiments of Boussingault on liming. The addition to the soils experimented upon of small quantities of neutral alkaline salts, or salts of alkaline earths, has appeared to be without effect.

Soils in which nitrates already exist are in general the seat of a more active nitrification. This comes not from these nitrates themselves, but from the *nitric ferment* already developed, and in the height of its activity, that accompanies them; the pre-existing nitre is only the indication of the presence of the ferment. Hence, in sowing the ferment in soils that were identical, except that some were exempt from nitrates, and the others received additions of variable quantities of pure nitrates, in no case was there any appreciable difference in the proportion of nitric acid formed.

It is well known that the presence of an organic material is necessary. Carbonaceous substances the most diverse, sugar, glycerine, alcohol, tartaric acid, albumine, &c., can furnish the carbon indispensable to this reaction, as well as the remains of organic matters, or the humus of the soil. The proportion is variable between the quantities of carbonic acid produced simultaneously. The part thus taken by the organic material is yet to be determined. We are of the opinion that the nitric ferment derives from this its carbonaceous element, and takes a large part in its destruction.

Nitrification takes place with an intensity sensibly equal in obscurity, and in places feebly lighted; but, in stronger light, there is, as Warrington has observed, a marked relaxation, that we believe due to some secondary phenomena. In the soil, where the surface particles are alone subjected to direct light, this influence cannot be considerable.

It will thus be seen that such of our soils that are rich in vegetable matter, containing a small quantity of lime, under the influence of our long and moderately dry summers and constantly aerated by careful cultivation, are the theatres of great chemical changes; prominent among which is the production of a large amount of nitric acid. If these soils be occupied by corn or cotton from March or April till late in the fall, it is evident that these crops may get the entire benefit of this nitrification and will need but small additions ef nitrogen in these manures. Further Mr. Lawes has shown by experiment (See results of his experiments, page —) that nitrates were formed most abundantly in summer and autumn and, and little if any in winter and spring. He has further shown that a bare fallow during summer favors the production of nitrates, but if the fallow be left bare during winter, a serious loss of nitrates ensues by drainage. The application of these facts we think throws a flood of light upon many phenomena hitherto but imperfectly understood. Let us apply them to *corn*: This plant belongs to the cereals, and the known demand of wheat, oats, barley, etc., for nitrogen, has established a law providing for an abundance of nitrogen in all manures prepared for these crops. Corn was classed with them, but it has been found that it does not always respond to larger doses of nitrogen. Why not? unlike the other cereals, it is planted in spring and not gathered until late in the fall, thus getting the benefit of all the nitric acid produced during this time. It does not respond to the nitrogenous manures, not that it does not need them, but because from amounts furnished by rains, from atmosphere and from soils, by nitrification, ample amounts are supplied for wants of the plant. On poor sandy soils destitute of vegetable matter, we should suspect nitrogenous manures of a permanent character would always pay, as in our experiments; especially if properly combind with phosphates snd potash. If mineral manures are wanting, even in soils filled with vegetable matter, corn will not thrive, since in absence of these it is unable to utilize all the nitric acid formed and the latter appears in the drainage water. Evidently these mineral manures are here needed and we expect those soils responding so well to mineral manures fulfill the above conditions. These facts show, we think conclusively, why corn gives different responses to different manures on different soils.

To cotton, the above remarks are also applicable. The cotton plant as a whole contains a large amount of nitrogen; while we know but a small amount is necessary in the manures best adapted to it; and this small amount must be mixed with a large quantity of phosphoric acid Why cotton does not require even as much nitrogen as corn, may we think be explained on two grounds. First, we cultivate much oftener and later in the season than corn, aerating and inducing greater nitrification and second its period of active growth extends further into the season than corn, and thus it gets the benefit of the heavey nitrification of late summer and early fall.

We think the above will explain the source of a large amount of nitrogen found in the cotton plant.

The ease and rapidity with which the grasses, (principally Crab Grass), take possession of our corn fields in late summer and fall, after the cessation of growth by the corn, is often noticeable. Grasses flourish the best, when supplied with heavy doses of nittrates. May not the nitric acid now so abundantly formed be the cause of the luxuriance of the grass? Again experience has taught us that our cow peas do best when planted late. Now the pea is regarded as a renovator of soils—indeed is still believed by many to have the power of assimulating nitrogen from air through its foliage and storing it in plant, ready when turned under, on account of its succulent nature to give it to the growing crop. May not the true explanation of its success as a late crop, and as a renovator of soils, be, that it finds abundant supplies of nitric acid at this season which it could not obtain earlier and storing it away in large quantities, is ready when decay comes to yield it up in an easily assimilable form.

Another thought on this subject. Our long dry summers without rains, while destructive to cotton and corn are followed by excellent small grain crops, especially if latter are grown upon fallow land or those just occupied by cotton and corn. The explanation may be, that the large amounts of nitric acid formed during the summer and fall, remaining unused in the upper layers of the soil, is ready, when dissolved by the rains of winter, to be used by the small grain. In this way the large small grain crop just harvested may be explained.

If all this be so, then we can draw some practical conclusions.

1. viz: Continuous cultivation develops an increase of nitrification, therefore we should aim to cultivate as long as safe to the plant.

2. If nitric acid formed during the summer and fall, is not utilized by growing crop, it will, if ground is unoccupied during the winter, be carried off by drainage. The custom of leaving our cotton fields bare and naked during winter, and the loss of nitrates by drainage may account for our exhausted soils. Surely something of this sort must be at work to deplete the fertility, since we know that the lint shipped from a plantation carries away an insignificant amount of fertilizing ingredients.

3. The necessity of restoring humus to our soils, which can be best obtained by a rotation which shall include the turning under of a green crop during the course.

COTTON FOR 1881.

Dr. Zellner, of Ashville, St. Clair county, Alabama, has for several years, been improving his cotton by yearly selections. His efforts have been so successful as to merit for this improved cotton the name of Zellner cotton. Several hundred bushels of his seed have been purchased by the Agricultural Department at Washington and distributed among the planters of the South. This variety of cotton seed was used exclusively in our experiments. It fact, several small experiments were made for the purpose of testing the excellence of this variety of cotton, in its varions stages of improvement. Through kindness of Dr. Zellner, we received small packages of seed, viz:

No. 1—Marked "sixth year selection, improved seed from lint, large bolled, prolific."

No. 2—Marked "fifth year selection from seed."

No. 3—Marked "very special selection of cluster."

These seed were planted 15th of April, and manured and cultivated with great care. Results—Twenty-two, nineteen and one hundred and thirty-four pounds respectively, of seed cotton. The seed from each of these plants were saved separately and will be used in our experiment the ensuing year. Besides this six pounds of the best cotton from each patch, was selected and seed therefrom saved for future improvement.

The regular experiments in cotton consisted of five acres, (designated No. 1, 2, 3, 4 and 5,) and some small outside patches.

Besides the regular acre experiments, the following was also made with the hope of results of some practical importance to our farmers. A small plat (size not accurately measured) was manured with cotton seed meal and dissolved bone, at the rate of two hundred pounds of each to the acre, well prepared and planted. There were eighteen rows of equal length and breadth on the plat. After the cotton was up every alternate row, beginning with first, was blocked out one hoe width, and every alternate row, beginning with second, was chopped to a stand of one and two stalks to a hill. The other culture was alike. Calling the odd alternate rows (*a*) and the even (*b*), we found that (*a*) nine rows, gave eighty-eight pounds seed cotton, (*b*) nine rows, gave eighty-five pounds seed cotton—results so closely agreeing, that no conclusions of a practical nature can be drawn.

The outside patches above mentioned yielded eight hundred and twenty-four pounds seed cotton.

ACRE EXPERIMENTS IN COTTON.

NUMBER ONE.

This acre was treated before breaking with a compost of
Twenty bushels leaf mould.
Twenty bushels cotton seed.
Forty bushels stable manure.
Four hundred pounds super-phosphate.

Divided, after planting, into two parts, (*a*) eighteen rows planted with Dr. Zellner's first selection of seed, and (*b*) twenty-two rows of Dr. Zellner's second selection of seed. The acre subsequently received in drill beside the cotton, two hundred pounds of cotton seed meal and two hundred pounds dissolved bones.

Results of (*a*)—422 pounds seed cotton.
(*b*)—464 " " "

NUMBER TWO.

This acre was manured in drill at planting, with two hundred pounds cotton seed meal and two hundred pounds dissolved bones, and at third plowing, June 11th, received alongside of cotton a mixture of one hundred pounds cotton seed meal and one hundred pounds dissolved bones. Zellner's seed of our selection was here used.

Results—1,195 pounds seed cotton.

NUMBER THREE.

Received in drill at planting two hundred and eighteen pounds cotton seed meal and two hundred and eighteen pounds dissolved bones, and at third plowing, June 9th, a further manuring of one hundred and nine pounds of each of above was given alongside of cotton. Zellner seed of our selection used

Result—953 pounds seed cotton.

NUMBER FOUR.

This was a bottom acre and our efforts were spent in trying to induce a very large yield upon it. Accordingly we gave it the same manuring as Number one acre. (See above). Results, 1766 pounds of seed cotton.

The drouth which prevailed during a greater part of the summer, effected Numbers one, two and three, which were upland. Previously these acres under similar treatment have yielded on an average of one bale to the acre. Number four, though in the bottom, escaped not the drouth without some detriment, since the record shows that it yielded under similar treatment in 1880, 2,200 pounds of seed cotton.

NUMBER FIVE.

This acre was devoted to a series of experiments for purpose of testing the following questions:

First—Which of the valuable ingredients of manure, nitrogen, (or ammonia) phosphoric acid and potash, are needed by cotton on our soil?

Second—Which form of nitrogen is best adapted to requirements of cotton—the nitrogen being furnished in form of nitrate of soda—sulphate of ammonia, dried blood and cotton seed meal? And,

Third—If nitrogen is needed what amount is necessary to make a maximum crop at greatest profit?

In use of these nitrogenous manures, such quantities of each were taken so as to give equal amounts of nitrogen. The following is the composition of the nitrogenous manures used:

Nitrate soda contained........	16	per cent. nitrogen.
Sulphate ammonia contained	21	" " "
Dried blood......................	11	" " "
Cotton seed meal..............	7	" " "

Such quantities of these were taken as to represent twenty-four pounds, forty-eight pounds and seventy-two pounds of nitrogen per acre, or one, two and three rations of nitrogen.

The cost of nitrogen per pound was twenty-five cents in nitrate soda, twenty-four cents in sulphate ammonia, twenty cents in dried blood, and fourteen cents in cotton seed meal. So that equal rations of nitrogen *in different forms*, *varied greatly in cost*. But our object was to learn, if possible, the preference of cotton for the various forms of nitrogen, and to determine only incidentally its cheapest form.

The acre was laid off in rows three feet wide and seventy yards long, and three rows taken for each experiment. I append below first the experiments and then the results, giving the time and amounts of each picking.

*No. 1, three rows	—Nothing.	
No. 2, three rows	—7½ pounds nitrate soda.	
*No. 3, three rows	—15 pounds super-phosphate.	
*No. 4, three rows	—7½ pounds muriate potash.	
*No. 5, three rows	7½ pounds nitrate soda. 15 pounds superphosphate.	
*No. 6, three rows	7½ pounds nitrate soda. 7½ pounds muriate potash.	
*No. 7, three rows	15 pounds super-phosphate. 7½ pounds muriate soda.	mixed minerals.
*No. 8, three rows	7½ pounds nitrate soda. mixed minerals.	
No. 9, three rows	18 pounds cotton seed meal. mixed minerals.	
*No. 10, three rows	15 pounds nitrate soda. mixed minerals.	
*No. 11, three rows	—Nothing.	
No. 12, three rows	36 pounds cotton seed meal. mixed minerals.	
No. 13, three rows	22½ pounds nitrate soda. mixed minerals.	
No. 14, three rows	54 pounds cotton seed meal. mixed minerals.	
*No. 15, three rows	5⅝ pounds sulphate ammonia. mixed minerals.	
No. 16, three rows	11¼ pounds sulphate ammonia. mixed minerals.	
No. 17, three rows	16⅞ pounds sulphate ammonia. mixed minerals.	
No. 18, three rows	11¼ pounds dried blood. mixed minerals.	

*No. 19, three rows { 22½ pounds dried blood.
mixed minerals.

*No. 20, three rows { 33¾ pounds dried blood.
mixed minerals.

*No. 21, three rows—18 pounds cotton seed meal.

*No. 22, three rows { 18 pounds cotton seed meal.
18 pounds Etiwan dissolved bone.

*No. 23, three rows—Nothing.

Those plats marked * were prepared and planted May 14th, the others May 17th, no rain intervening.

By mixed minerals in all of the above plats, we mean fifteen pounds superphosphate and seven and one-half pounds muriate potash.

The superphosphate used contained 16 per cent. phosphoric acid, except in Experiment 22. The Etiwan bone there used contained 14 per cent. The muriate of potash contained 50 per cent. potash.

RESULTS OF EXPERIMENTS WITH TIME, AND AMOUNTS OF EACH PICKING, &C.

No. of Experiment.	1st Picking, 22d Sept.	2nd Picking, 30th Sept.	3rd Picking, October 6th.	4th Picking, Octob'r 12th.	5th Picking, October 21st.	6th Picking, Nov. 2nd.	Total of each Experiment.	Total per acre.
1	9 lbs.	7 lbs.	4 lbs.	3 lbs.	2 lbs.	½ lbs.	25½ lbs.	586½ lbs.
2	6	12½	8	5	2½	1	35	805
3	21½	14	7	3	2	3	50½	1161½
4	3	7	8	3	2½	1	24½	563½
5	21	26½	10	5	4	3	69½	1598½
6	14	11	8	3	3	1½	40½	931½
7	17	16½	11	3	3	2½	53	1219
8	21	22½	10	4½	5	4	67	1541
9	13	17	11	5	5	3½	54½	1253½
10	14	16	12	8	6	5	61	1403
11	5	5½	3	1	½	……..	15	345
12	13½	19	15	8	5½	5	66	1518
13	10	15	11	7	7	4	54	1248
14	7	17	14	8	8	4½	58½	1345½
15	10	17½	11	5	2½	2½	48½	1115½
16	13	16	14	6	4	2	55	1265
17	13	15	9	6	5	2½	50½	1161½
18	20	19	10	4	3	3	59	1357
19	14	14½	12	7	5	4	56½	1299½
20	10	14	9½	7	5	3½	49	1127
21	8	11	9	3	2	2	35	805
22	25	14	9	5	4	2	59	1357
29	4	6	4	3½	1½	½	19½	448¼

REPLIES TO FIRST QUESTIONS.

POTASH.

The first question propounded; which of the valuable ingredients is needed by our soil, is answered very emphatically by experiments from one to ten. Potash, as indicated by these experiments, is not needed by cotton on this soil. Number 1, where nothing is used yields 586½ lbs. per acre. Where number 4, with over 70 lbs. Potash to acre, yields only 563½ lbs. Again number 5, with Nitrate of Soda and Superphosphate, yields 1598½ lbs. per acre, while number 8, with same ingredients, plus 70 lbs. Potash per acre gives only 1541 lbs. per acre—differences due evidently to nature of soil. These experiments are confirmatory of others previously made, and while we have not the data on which to base an unqualified assertion in regard to most of the soils of our State as to their want of potash for growing cotton—still we are constrained to believe that much of the potash now sold in our State, is as utterly worthless in its effects as that used above. With the exception of the southern portion of our State, and that part lying within the belt of the true drift (and about these I am yet in doubt), it may be safely asserted I think, that for *growing cotton*, our State as a whole, does not need potassic fertilizers. We make this assertion because our markets contain fertilizers with or without potash which are used by our farmers indiscriminately, and so far as I have observed, without any apparent difference in favor of those containing potash. If then, our soils do not need potash we evidently lose the money paid for this ingredient in our fertilizer. Merryman's Ammoniated Superphosphate, one of the most popular and reliable of all the fertilizers sold in this State and Georgia, has never contained any potash. Of course my remark above must not be construed to apply literally to every field and every patch. Experiments upon every field and patch would have to be made before such an assertion could be affirmed. But I do not think that any large portion of land as a whole, is benefited by application of potash as manures.

PHOSPHORIC ACID.

If these experiments responded negatively in regard to wants of this soil for potash, they gave positive assurances of the absolute need of phosphoric acid by this soil for cotton. Number 3, where only a superphosphate was used yielded 1161 lbs. per acre; an increase of 575 lbs. over number 1, where nothing was used. In fact we find phosphoric acid to be the leading ingredient in manures for cotton, and imitating the example of Prof. Ville, we should pronounce it the "dominant" one. Especially is this the case in the older cotton States, where crops of cotton have been almost anually removed, for over a half century. This constant growing of a single crop, and the denudation of the surface, subjected so long to a clean culture, have tended to well nigh exhaust the quantity of available phosphoric acid which these soils originally possessed. Hence, from Virginia to Mississippi superphosphates are more or less universally used, and their growing popularity attests their high value as a manure for cotton.

VALUE OF PHOSPHORIC ACID IN SEED COTTON.

We have for several years experimented with the view of determining the rates of seed cotton produced to the phosphoric acid used. By examining closely the results of above experiments we can find out approximately the number of pounds of seed cotton which one pound of phosphoric acid produced. In experiment number 3, fifteen pounds of superphosphate containing sixteen per cent. phosphoric acid or 2.4 pounds yielded an excess over number 1, of twenty-five pounds of seed cotton or a little over ten pounds to one pound of phosphoric acid used. In number 7, regarding the potash as being of no influence, we have comparing with number 1, a gain of over eleven pounds of seed cotton to one of acid. Compare twenty-one and twenty-two, and the gain is ten pounds. Hence we may in the above put ten pounds of seed cotton as about the average of the yield of one pound of phosphoric acid. Previous experiments have given from nine to ten pounds. One pound of available phosphoric acid is valued by the Department of Agriculture of Georgia, at 12½ cts. per pound. Assuming this valuation as our basis, (though we think it too high), then ten pounds of seed cotton cost us in phosphoric acid 12½ cts. or 1¼ cts. per pound. This is the apparent cost of cotton with superphosphate alone. When the latter is properly combined with nitrogenous matter, the yield, as we shall presently notice, is greater. Whenever, therefore, a farmer uses a superphosphate containing 12 per cent. of available phosphoric acid, at rate of 200 pounds per acre, (other circumstances being favorable), he should expect to get an increase in his crop of at least 240 pounds to the acre. Another benefit which accrues from the use of superphosphate, is the early maturity of the crop. This is especially desirable in the lower cotton States since we are nearly always, more or less disturbed by the worms late in the season. The use of superphosphates so hastens the maturity of the crop, as to often place the latter beyond hurt from an attack of the caterpillar. A close examination of above results will show, that when superphosphates, (except those used with excessive quantities of nitrogen) were used, the larger part of the crop was gathered before October 1st. Compare experiments 2, 5, 7, and 22.

NITROGEN

Is also needed by this soil for cotton, but its effect is not so marked as those of phosphoric acid. Experiment number 2, gains nine and one-half lbs. over number 1, an amount chargeable entirely to seven and one-half lbs. of nitrate of soda—or at rate of 218½ lbs. per acre, while number 5 gains nineteen lbs. over number 3, or 438 lbs. per acre. The excess of number 21 over 23, is sixteen and one-half lbs.—but since cotton seed meal contains 3 per cent. phosphoric acid, a part of this increase is properly chargeable to it. Deducting this at rate of ten lbs. of seed cotton for one of phosphoric acid, and we will have nearly eleven and one-half lbs. as increase due to nitrogen of the cotton seed meal. There seems to be a positive increment for nitrogen alone and a higher one when properly combined with phosphoric acid e. g. the positive increment for nitrogen alone in number 2, is nine and one-half lbs. of seed cotton for every twelve lbs. nitrogen used We have al ready placed the value of one lb. of phosphoric acid at ten lbs. seed cotton. Applying these two values to number 5 we should have 34½ lbs. as the increase over number 1, but we find in reality 44 lbs., leaving nine and one-half lbs. to be accounted for in some other way, which we believe is due also to nitrogen having in this instance been more fully utilized on account of phosphoric acid present, than in number 2. Alone, by experiment 2, one lb. of nitrogen yields about eight lbs. seed cotton. Combined in number 5, after deducting twenty-five lbs. for phosphoric acid, one lb. yields about double that amount. From the above results, it would be fair to assume, that when small quantities of nitrogenous manures are used that every lb. of nitrogen should be expected to yield from eight to ten lbs. of seed cotton. Nitrogen, as above stated, varies greatly in cost, fourteen cents in cotton seed meal to twenty-five cents per lb. in nitrate of soda, and therefore, we cannot assign to it a fixed price and deduce therefrom the cost of increase of seed cotton, unless we knew the exact yield of nitrogen in its various forms. But since this is entrenching upon the other questions asked of our experiments we will defer further consideration until they are noticed.

RESULTS.

Summing up our results, we would say that, for cotton on our soils potash has but little or no effect, nitrogen more and phosphoric acid most of all. Further, to get the greatest results nitrogen and phosphoric acid must be used conjointly. The exact proportion of combination will be asked of some experiments next year, while the form in which the nirogen should be presented to the plant, is the second question propounded to these experiments.

QUESTION SECOND.

WHICH FORM OF NITROGEN IS BEST ADAPTED TO REQUIREMENTS OF COTTON?

In above experiments nitrogen, in forms of nitrate soda, sulphate ammonia, dried blood, and cotton seed meal, was used. Such quantities of each were taken as to represent equal amounts of nitrogen. One, two and three rations of each, with mixed minerals, were used. Let us tabulate each.

Results of one ration, at rate of twenty-four pounds of nitrogen per acre:

No. 8	—7½ pounds nitrate of soda produced	pounds	47
9	—18 pounds cotton seed meal	"	54½
15	—5⅝ pounds sulphate ammonia	"	48½
18	—11¼ pounds dried blood	"	59
	Total		229

Results of two rations, at rate of forty-eight pounds of nitrogen per acre:

No. 10	—15 pounds nitrate of soda	pounds	61
12	—36 pounds cotton seed meal	"	66
16	—11¼ pounds sulphate ammonia	"	55
19	—22½ pounds dried blood	"	56½
	Total		238½

Results of three rations, at rate of seventy-two pounds of nitrogen per acre:

No. 13	—22½ pounds nitrate of soda	pounds	54
14	—54 pounds cotton seed meal	"	58½
17	—16⅞ pounds sulphate ammonia	"	50½
20	—33¾ pounds dried blood	"	49
	Total	pounds	212

A simple inspection of above assures at once that nothing is gained by adding large quantities of nitrogen in any form to mannres for cotton. We are even of the opinion that the one ration of twenty-four pounds of nitrogen is too much, and may be reduced one-half without material reduction of yield. This fact is a very gratifying one, since nitrogen is the most costly ingredient of all fertilizers, and is growing scarcer and scarcer each year; and while large quantities of it are deemed necessary for the raising of small grain, and must be had, at any price, for the production of the bread of the world, the cotton planter, with proper economy, can read with indifference the market reports of the steady advance of this valuable element. Another gratifying fact is also presented by these experiments. Nitrogen at fourteen cents per pound in our cotton seed meal, (giving no value to its three per cent. of phosphoric acid and two per cent. of potash,) yields on an average nearly as much as nitrogen in nitrate of soda (which costs twenty-five cents per pound,) and more than that in sulphate of ammonia and dried blood. (See table in Professor Atwater's letter.) Hence its value in cotton seed meal, as a fertilizer for cotton, is but little inferior, if not the equal, of nitrogen, in that form which is universally acknowledged to be the best and highest, viz—nitrate of soda. Therefore I say, with proper economy, with proper utilization of his own cotton seed, supplemented by such home-made manures (rich in nitrogen,) as can be made and saved upon every plantation, the southern planter needs no imported nitrogen to grow his crops.

When we remember the proximity of the large phosphate beds of Charleston, South Carolina, out of which are made nearly all of the superphosphates which supply our soils with that much needed ingredient, phosphoric acid; when we remember that our chief staple can be furnished with all the needed nitrogen from home resources, and that potash when needed can be obtained from the ashes of our extensive forests, thus furnishing from southern soil all the needful ingredients to grow our southern staple, it is with feelings of pride and pleasure that we contemplate the vast capabilities and magnificent possibilities of southern agriculture in the near future.

I append herewith a letter touching the above from Professor W. O. Atwater of Middletown University, Connecticut, who has been for years an earnest and patient laborer in the investigation of agricultural matters, both in the field and laboratory:

WESLEYAN UNIVERSITY,
MIDDLETOWN, CONN., Jan. 5, 1882.

Professor W. C. Stubbs,
Alabama Agricultural and Mechanical College:

MY DEAR SIR: Your favor of the 30th ultimo, with report of special nitrogen experiments with cotton, is just at hand. Please accept thanks for same.

The results seem to me very interesting and valuable The potash as you say appears to have very little effect, the nitrogen more, and the phosphoric acid most of all. In how far these facts are factors of the soil, and to what extent they are due to the feeding capacity of the plant, are things to be further investigated, of course. It is, however, interesting to note that while the one-third nitrogen ration in each of the three nitrogen groups materially increases the yield, or at least appears to, the yield, instead of rising with the larger applications of nitrogen, actually falls. I have put your figures together so as to show this.

Assuming the yield on plat number seven, to represent what would be the yield in each case with superphosphate and potash salt, we have yields of cotton and gains due to nitrogenous fertilizers as follows:

Nitrogenous Fertilizers.	*Amount of Nitrogen.*		
	24 lbs.	*48 lbs.*	*72 lbs.*
Nitrate of soda	1,545 pounds.	1,403 pounds.	1,242 pounds.
Sulphate of ammonia	1,115	1,265	1,162
Dried blood	1.357	1,300	1,127
Average of above	1,338	1,323	1,177
Mixed minerals	1,219	1,219	1,219
Gain from nitrogen	119	102	—42
Cotton seed meal	1,253	1,518	1,345
Mixed minerals	1,219	1,219	1,219
Gain from nitrogen	34	299	126

Thus in the nitrate-of-soda group, numbers eight, ten, and thirteen, the number eight, with twenty-four pounds of nitrogen per acre, shows an increase of over three hundred pounds over number seven, "mixed minerals," while in numbers ten and thirteen the amount decreases so as to show with seventy-two pounds of nitrogen in number thirteen no increase over number six.

The results with the sulphate-of-ammonia group show practically no increase, indeed, if anything, a falling off of nitrogen. Nor are they much more favorable with dried blood; indeed, here, while there is a slight gain with the one-third ration, the others fall off until with the full ration there is a decided decrease, as compared with the yield with no nitrogen at all.

In short, one can almost say that the more nitrogen there is applied, the less cotton is produced.

These figures agree very emphatically in testifying that the large quantities of nitrogen in the commercial forms were very unprofitable.

The figures for cotton seed meal are striking.

Lumping the gains with the several nitrogenous materials together, we have more with this than with either sulphate of ammonia or dried blood, and about the same as with nitrate of soda. Thus the total yields are:

	Nitrate Soda.	Sulph. Amm'a.	Dried Blood.	Cotton seed Meal
⅓ Ration	1545	1115	1357	1253
⅔ "	1403	1265	1300	1518
Full "	1242	1162	1127	1345
Sum.	4190	3542	3774	4116

That is to say according to the testimony of these experiments.

1. In return for twenty-four pounds of nitrogen per acre in Commercial Fertilizers, which would cost near the large sea-board markets at present prices, cash, say (twenty-four pounds, at twenty-five cents per pound, six dollars, and in the interior on time a good deal more, you get, on the average, one hundred and nineteen pounds of cotton. When you double the amount of nitrogen, you get less increase; trebling it, you have a loss.

2. But when instead of using these imported products you put back on your land the cotton seed, it has already produced enough to furnish the same quantity of nitrogen (about two pounds of cotton seed meal for one of nitrate of soda, and three for one of sulphate of ammonia) you get as much, as with the nitrate of soda and more than with anything else.

Of course, no wise man will proclaim a general principal from a single series of experiments. Still these results are certainly striking and suggestive. There are two questions in particular which they suggest anew to me as doubtless they have done to you:

First, where, how, and in what quantities can nitrogen be used with profit to grow cotton?

Second, if this element, which is already scarce and costly and growing scarcer and costlier year by year, is necessary to make cotton grow is it better for planters to send their money to distant dealers who must search the North, East and West, and even send to foreign lands to obtain it, or to utilize a home product that furnishes the nutrition at vastly less cost and a lot of phosphoric acid and potash besides? The farmers and planters of Georgia and other Southern States are importing millions of dollars worth of nitrogen every year. Is this wise, and how can the question as to the economy be solved otherwise than by direct experiment?

I have thus hastily and crudely set down some of the things that first occur to me from very brief study of your experiment. My object is not to assume the position of interpreter, but rather to inquire if these ideas agree with your own, and to ask if you will not kindly favor me with your own interpretations and suggestions. I should regard it as an especial favor if you would furnish me your comments for publication with your experiment.

At the convention to be held at the Agricultural Department in Washington January 10th and 11th, I may find occcasion with your permission to say something about your experiments in connection with others. If you should be present I should be very glad to talk them over with you. If not, could you find it convenient to send me any suggestions?

Looking for valuable work from you in the future, I remain,

Yours Very Truly,

W. O. ATWATER.

QUESTION THIRD.

We are compelled to resort to other experiments to have this question answered—the above showing no gain for increased portions of Nitrogen. A series of experiments have been devised, which will be executed the ensuing year, looking to a partial solution of this question.

All of these experiments will be repeated upon some ground and in same manner for the ensuing year—indeed for several years to come, if we continue to exercise our will in the matter. They will become, we hope, more instructive and interesting every year.

EXPERIMENTS IN COTTON FOR 1882.

Four sets of experiments in cotton were conducted during the present year, which will be explained in their order.

SERIES I.

This was a repetition of experiment No. 5, in cotton last year. As soon as the cotton was picked last year, each plot was plowed separately and land allowed to remain in fallow, till April, at which time it was replowed, each plot again divided into three rows and the same experiments of last year, and upon same plots with manures used:

No. 1, three rows—Nothing.
No. 2, three rows—7½ pounds nitrate soda.
No. 3, three rows—15 pounds superphosphate.
No. 4, three rows—7½ pounds muriate potash.
No. 5, three rows—7½ pounds nitrate soda; 15 pounds superphosphate.
No. 6, three rows—7½ pounds nitrate soda; 7½ pounds muriate potash.
No. 7, three rows—15 pounds superphosphate; 7½ pounds muriate potash; mixed minerals.
No. 8, three rows—7½ pounds nitrate soda; mixed minerals.
No. 9, three rows—18 pounds cotton seed meal; mixed minerals.
No. 10, three rows—15 pounds nitrate soda; mixed minerals.
No. 11, three rows—Nothing.
No. 12, three rows—36 pounds cotton seed meal; mixed minerals.
No. 13, three rows—22½ pounds nitrate soda; mixed minerals.
No. 14, three rows—54 pounds cotton seed meal mixed minerals.

No. 15, three rows—5⅝ pounds sulphate ammonia; mixed minerals.
No. 16, three rows—11¼ pounds sulphate ammonia; mixed minerals.
No. 17, three rows—16⅞ pounds sulphate ammonia; mixed minerals.
No. 18, three rows—11¼ pounds dried blood; mixed minerals.
No. 19, three rows—22½ pounds dried blood; mixed minerals.
No. 20, three rows—33¾ pounds dried blood; mixed minerals.
No. 21, three rows—18 pounds cotton seed meal.
No. 22, three rows—18 pounds cotton seed meal; 18 pounds Etiwan dissolved bone.
No. 23, three rows—Nothing.

These manures had same composition and cost as those used in 1881.

The acre was planted April 20th, 1882, with McKinnon's Herlong cotton, received from Mr. K. McKinnon, Pleasant Hill, Dallas county, Alabama.

CULTIVATION.

May 11th, Ross horse hoe.
May 18th, chopped out to a stand.
May 27th, wing sweep.
June 9th, wing sweep.
June 22nd, wing sweep.

I append results of this year and the aggregate results of 1881, for comparison.

No. of Experiment.	1st Picking, Sept. 7th.	2nd Picking, Sept. 15th.	3rd Picking, Sept. 27th,	4th Picking, Oct. 8th.	5th Picking, Oct. 23rd.	6th Picking, Nov. 8th.	Total of each Experiment.	Total per acre.	Results of 1881	
									Total.	Total per acre.
1	2 lbs.	11 lbs.	8 lbs.	7¼ lb	4½ lb	½ lb	33¼ lb	764¾ lb	25½ lb	586½ lb
2	3	8	9½	8¾	4	1¼	34½	793½	35	805
3	5	14½	9	8	2	¼	38¾	891¼	50½	1161½
4	3½	7	8	8½	5	1½	33½	760½	24½	563½
5	8	23	15	11¼	3	½	60¾	1397¼	69½	1598½
6	5	7	9½	17	10¼	4	52¾	1213¼	40½	931½
7	3	13	10	12	5	1¼	44¼	1017¾	53	1219
8	10	19	13½	8¼	4½	1¼	56½	1299½	67	1541
9	9	16½	14	9	3	3	54½	1253½	54½	1253½
10	11	15	16	15½	9	4	70½	1621½	61	1403
11	......	2	2½	4	1½	¼	10¼	235¾	15	345
12	5½	20	14	15	8¼	3	65¾	1512¼	66	1518
13	4	15	16	16¼	13¼	5	69½	1598½	54	1248
14	5	24	20	19½	13	3¼	84¾	1949¼	58½	1345½
15	3½	17	11	9	11½	1	53	1219	48½	1115½
16	5	15½	14¾	13	4½	3	55¾	1282¼	55	1265
17	7	11	15	14	9	4½	60½	1391½	50½	1161½
18	4	18¼	13¼	7½	4	½	47½	2092½	59	1357
19	9	19	14½	10	7	2½	62	1426	56½	1299½
20	16	19	16½	15	8½	3	78	1794	49	1127
21	16¼	11	8	4½	2¾	1¼	43¾	1006¼	35	805
22	7½	18	9	5½	2¼	½	42¾	983¼	39	1357
23	1½	4	3½	3½	3½	1½	17½	402½	19½	448½

The question propounded last year—"which of valuable ingredients is needed by our soil?" is answered about as last year—No. one, where nothing is used, yields 764¾ pounds per acre, while No. four, with a large amount of potash yields only 760½ pounds per acre. Comparing five and eight, we find an absolute loss when potash was used. Again our experiments seem to indicate that our soil does not need potash for the growing of cotton. Phosphoric acid has not on the whole, the effect of last year—while it has increased the crop in every instance, this increase has been smaller than last year. Nitrogen has given about the same yields as last year.

Considering the very favorable season, we may say that results of this year are in the main, fairly concordant with those already reported for '82.

SERIES II.

In this series, our aim was to test the exact proportions that Nitrogen and Phosphoric acid should be mixed, and what quantities of the mixture would give the greatest profit. This series was seriously interfered with by rust, which nearly destroyed the crop early in the season. Plats of one-fiftieth of an acre were laid off and forty-one of these taken for the experiments. Cotton seed meal was used to furnish the Nitrogen and Etiwan dissolved bones to furnish the phosphoric acid.

The following are number of plats, manures used and ratio of nitrogen to phosphoric acid:

No.	MANURE USED.	Ratio of Nitrog'n to Phos. Acid
1	Nothing	
2	1 ℔ Cotton Seed Meal	3½ — 1
3	1 " " " " and .3 ℔ Dissolved Bone	1 — 1
4	1 " " " " " .54 " " "	1 — 1½
5	1 " " " " " .78 " " "	1 — 2
6	1 " " " " " 1.04 " " "	1 — 2½
7	1 " " " " " 1.28 " " "	1 — 3
8	1 " " " " " 1.54 " " "	1 — 3½
9	1 " " " " " 1.8 " " "	1 — 4
10	1.8 ℔s Dissolved Bone	
11	Nothing	
12	2 ℔s Cotton Seed Meal	7 — 3
13	2 " " " " and .6 ℔ Dissolved Bone	1 — 1
14	2 " " " " " 1.08 " " "	1 — 1½
15	2 " " " " " 1.57 " " "	1 — 2
16	2 " " " " " 2.08 " " "	1 — 2½
17	2 " " " " " 2.57 " " "	1 — 3
18	2 " " " " " 3 08 " " "	1 — 3½
19	2 " " " " " 3.6 " " "	1 — 4
20	3.6 ℔s Dissolved Bone	
21	Nothing	
22	4 ℔s Cotton Seed Meal	14 — 6
23	4 " " " " and 1.2 ℔s Dissolved Bone	1 — 1
24	4 " " " " " 2.16 " " "	1 — 1½
25	4 " " " " " 3.14 " " "	1 — 2
26	4 " " " " " 4.16 " " "	1 — 2½
27	4 " " " " " 5.14 " " "	1 — 3
28	4 " " " " " 6.16 " " "	1 — 3½
29	4 " " " " " 7.2 " " "	1 — 4
30	7.2 ℔s Dissolved Bone	
31	Nothing	
32	8 ℔s Cotton Seed Meal	28 —12
33	8 " " " " and 2.4 ℔s Dissolved Bone	1 — 1
34	8 " " " " " 4.32 " " "	1 — 1½
35	8 " " " " " 6.28 " " "	1 — 2
36	8 " " " " " 8.32 " " "	1 — 2½
37	8 " " " " " 10.28 " " "	1 — 3
38	8 " " " " " 12.32 " " "	1 — 3½
39	8 " " " " " 14.4 " " "	1 — 4
40	14.4 lbs Dissolved Bone	
41	Nothing	

I append results:

No. of Experiment.	1st Picking, Sept. 7th.	2nd Picking, Sept. 15th.	3rd Picking, Sept. 28th.	4th Picking, Nov. 2nd.	Total.	Total per acre.
1	1 lb.	1.5 lbs.	1.1 lbs.	.47 lbs.	4.07 lbs.	203½ lbs.
2	1	3	.5	.62	5.12	256
3	.5	1.5	.84	.38	3 22	161
4	.5	1.5	.88	.56	3.44	172
5	1	1 5	1.03	.57	3.60	180
6	1	1.5	.77	.5	3.77	188½
7	1	1	.81	.56	3.47	173½
8	1. 5	1.5	.35	.45	3.80	190
9	1. 5	.5	1.1	.7	3.80	190
10	1	1	.88	.31	3 19	154½
11	....	.25	.84	.35	1.44	72
12	1	1	.40	.7	3.10	155
13	2	1	.51	.5	4.01	200½
14	2	1.25	1.03	.45	4.73	236½
15	1	1	.88	.3	3.18	154
16	1	1 5	.77	.35	3.63	181
17	1	1.5	.84	.5	3.81	190½
18	1.25	1.75	.81	.4	3.75	187½
19	1.5	1.25	1.1	.4	4.25	212½
20	.5	1.5	.88	.47	3.35	167½
21	....	.5	.51	.62	1.63	81½
22	....	.5	.77	1	2.27	113½
23	1	2.5	.84	.56	4.90	245
24	2	3	.81	.45	6.26	313
25	3	3.25	1.1	.5	7.85	292½
26	2	2 25	.88	.25	5.38	269
27	2	2	1.03	.31	5.34	267
28	....	2.5	.51	.31	3.32	166
29	....	2.25	.88	.4	3.53	176½
30	1	2	.35	.56	3.91	195½
31	1	5	.77	.57	2.84	142
32	2	2.5	.81	.875	6.185	309½
33	2	4	.84	.7	7.54	377
34	4	4	1.1	.75	9.85	492½
35	3	4	1.03	.81	8.84	442
36	4	5	.77	.84	10.61	530½
37	5	4	.88	.75	10.63	531½
38	4	5	.5	.5	10	500
39	5	3.5	.81	.62	9.93	496½
40	2	5	.34	.81	8.16	408
41	.5	5	1.1	1.2	3.3	165

This series was prepared, planted and cultivated as No. 1. Results here are entirely unsatisfactory, the rust having utterly destroyed the value of the experiments.

SERIES III.

In experiments of last year (No. 5 of '81), it was found that the increased rations of Nitrogen did not increase the yield of cotton. Even one ration of Nitrogen was believcd to be too much for cotton. Accordingly a series of experiments, similar to Series I., was instituted, in which the Nitrogen was reduced to 1-6, ⅓, and ⅔ of a ration, using Nitrate Soda, Sulphate of Ammonia and Dried Blood. I append experiments.

No. 1—1½ pounds Nitrate Soda and six pounds Superphosphate.
No. 2—6 pounds Supherphosphate and 3 pounds Muriate Potash and mixed minerals.
No. 3—Mixed Minerals and 1½ lbs Nitrate Soda (1–6 Ration)
“ 4 “ “ “ 3 “ “ “ (⅓ “
“ 5 “ “ “ 6 “ “ “ (⅔ “
“ 6 “ “
“ 7 “ “ “ 1⅛ “ Sulph. Am'a (1–6 “
“ 8 “ “ “ 2¼ “ “ “ (⅓ “
“ 9 “ “ “ 4½ “ “ “ (⅔ “
“ 10 Nothing.
“ 11 Mixed Minerals.
“ 12 “ “ “ 2¼ “ Dried Blood (1–6 “
“ 13 “ “ “ 3½ “ “ “ (⅓
“ 14 “ “ “ 9 “ “ “ (⅔ “

WITH FOLLOWING RESULTS.

No of Experiment.	1st Picking, Sept. 7th.	2nd Picking, Sept. 15th.	3rd Picking, Sept. 27th.	4th Picking, Nov. 1st.	Total.	Total per acre.
1	2 lbs.	3 lbs.	1.47 lbs.	1 57 lbs.	8.04 lbs.	402 lbs.
2	3.25	4	2.75	2.72	12.72	636
3	1	4.25	2.84	2.84	10.93	546½
4	1.5	4	4.20	5.35	15.05	752½
5	2	4.5	4.75	7.84	19.09	954½
6	2.5	3	2.31	3.10	10.91	545½
7	1	5	3.23	4.94	14.17	708½
8	3	6	4.38	6	19.38	969
9	1.75	7.25	5.85	7.53	22.38	1119
10	2	2	1.43	1.81	7.24	362
11	3	4	3.45	5.22	15.67	783½
12	1.5	6.5	5.3	8.44	21.74	1037
13	2	7	4.47	7.81	21.28	1064
14	2.5	6	2.9	8.6	20	1000

1 should have stated that each plat here was one-fiftieth of an

acre, was prepared, planted and cultivated as series one. Zellner's 6th year selection cotton was here used as seed.

		Inc. over Mixed Minerals.
Nothing, No. 10	362 ℔s.	
Average of Mixed Minerals, Nos. 2, 6 & 11	655	
Average of 1-6 Ration Nitrogen, Nos. 3, 7 & 12	764	109 lbs.
" " 1-3 " " 4, 8 & 13	928½	272½
" " 2-3 " " 5, 9 & 14	974½	319½
" " 1-6 " " over Nothing	402	
" " 1-3 " " " "	566½	
" " 2-3 " " " "	612½	

SERIES IV.

This series of experiments was instituted to determine the comparative values of Phosphoric Acid, in its soluble, reduced and insoluble forms. For the soluble, we used a Dissolved Bone, for the reduced a Dissolved Bone reduced by addition of lime and for insoluble we used Fine Ground Carolina Phosphate, the "ash element" Fine Medium and Coarse Ground Bone, Ashes of Cotton Seed Hulls, and Bones reduced by treatment with Ashes, Lime and Soda.

Since the introduction of Liebeg's mineral theory, commercial fertilizers have been used. Large quantities at a vast outlay of money and labor are annually manipulated. Superphosphates constitute the whole or a part of every good Fertilizer. Its manufacture is an expensive one and consists in treating bones, (raw or burnt) or a mineral phosphate with sulphuric acid. Bones or mineral phosphate consists wholly on in part of tri-calcic phosphate i. e., three parts of lime combined with one part of phosphoric acid. In this condition it is insoluble in water and hence has but little if any immediate effect upon plant growth. By treating with sulphuric acid and water, the former removes two parts of lime from the bones and two parts of water is substituted therefore, making a mono-calcic phosphate and sulphate of lime (gypsum) which together are styled superphosphate, dissolved bones or acid phosphate. This mono-calcic phosphate is one part of lime, two parts of water and one part of phosphoric acid. This is readily soluble in water and is therefore immediately available for plant use. In the manufacture of superphosphates a part of the original phosphate is left untouched by virtue of a deficiency of sulphuric acid used. Again, some mineral phosphates contain some Iron and Alumina. In the first case the insoluble phosphate acts upon the soluble phosphate and gives us as a result a phosphate not soluble in water but soluble in certain salts, notably, citrate of ammonia. The name of "reduced" or "reverted" has been given to this. The same results ensue, if iron and ammonia are present, in a superphosphate made from mineral phosphate. In either case we have a reduced phosphate consisting of two parts of lime, one part of water and one part of phosphoric acid and is known to chemists as the Bi or Di calcic phosphate. The soluble phosphoric acid, is regarded by some chemists (Voelcker, Lawes, Johnson, &c.,) as of higher value than either of the other. On the other hand, others, (e. g. Commissioner of Agriculture for Georgia,) place the same value upon soluble and reduced, and call the two together, available phosphoric acid. Whether they are of the same agricultural value is a much mooted question and experiments three and four were instituted to give some light on this subject.

It is claimed by some, that the end accomplished in treating bones with sulphuric acid is to attain that fineness of division which enables the plant to take it up—since in nearly every soil either the lime, iron or alumina, reduces the superphosphate to the insoluble form soon after its application as a manure. After this reduction, the particles are so finely comminuted, that it is claimed the plant can at once utilize them. Can the same result be accomplished by mechanically dividing the bones or mineral phosphates? Such a claim is put forward by some men eminent in science and agriculture and human ingenuity has essayed the task with more or less success. Buhr stones were first used, which gave us a product admirably adapted for after treatment with sulphuric acid—but under the microscope, each particle infinitely too large for the small pores of the roots of plants—(we use samples of this in Exs. 7 and 8). Next we have an ingeniously constructed attrition mill invented and patented by Mr. Duc, and called the "Duc Atomizer." "This machine, with a yield of about six tons in ten hours and consumption of twenty-five horse power, reduces the phosphate to a uniform impalpable powder, showing under the microscope 30,000 particles to linear inch" In this form it is sold as "Floats" and used in Ex. 6. The late Dr. Ravanel of Charleston, S. C., first conceived the above views and instituted a series of remarkable experiments on the farms belonging to the Stono and Atlantic Phosphate Companies, to test the practical value of these views.

He mixed together equal parts of calcined marl, from Eocene marl beds of Carolina coast, finely ground Charleston phosphate (by Duc Mill) and alkaline salts from Leopolshald, Germany, and called it "Ash Element." This "ash element" is used in Exs. 9 and 10. The ashes of cotton seed hulls are obtained by burning the hulls in the furnaces of the engines used in the oil mills and contain about 10 per cent. insoluble phosphoric acid and 15 per cent. potash.

The questions which we propose these experiments to answer are, Which form of phosphoric acid is best adapted for cotton, taking into consideration cost and availability? Is the reduced equal in agricultural value to the soluble? Can the insoluble, either in form of fine medium or coarse bone, bones reduced by ashes, ground mineral phosphates, either by Buhr stones or Duc Mill, or as ash element, take the place of the soluble in vegetable nutrition. These are questions of paramount importance to the farmer, involving, if answered in the affirmative, the annual saving of millions of dollars. It will take the results of many years experiments, conducted on different soils and under varying circumstances, to give emphatic replies. I append experiments.

EXPERIMENTS.

No. 1—Nothing.
No. 2—Two pounds cotton seed meal.
No. 3—Two pounds cotton seed meal and 2 pounds dissolved bone and 1 pound slaked lime put in separately and not in contact with dissolved bone.
No. 4—Two pounds cotton seed meal and 2 pounds dissolved bone mixed intimately with 1 pound slaked lime before putting in.
No. 5—Two pounds cotton seed meal and 1 pound gypsum.
No. 6—Two pounds cotton seed meal and 2 pounds fine raw phosphates (floats by Duc atomizer) passing easily through sieve 70 meshes to square inch.
No. 7—Two pounds cotton seed meal and 2 pounds medium raw phosphate, ground by Buhr stones.
No. 8—Two pounds medium raw phosphates, ground by Buhr stones.
No. 9—Two pound ash element— { 24.27 per cent. phos. lime. / 3.4 " " potash.
No. 10—Two pounds cotton seed meal and 2 pounds ash element.
No. 11—Two pounds cotton seed meal and 2 pounds ashes cotton seed hulls.
No. 12—Two pounds cotton seed meal and 2 pounds fine ground bone.
No. 13—Two pounds cotton seed meal and two pounds medium ground bone.
No. 14—Two pounds cotton seed meal and 2 pounds coase ground bone.

No. 15—Two pounds cotton seed meal and 5 pounds bones reduced as per formula on page 87.

No. 16—Five pounds bones reduced as per formula on page 87.

Each of these plats were 1-50 of an acre in size, and were prepared, planted and cultivated as the rest. Rust in several places appeared and injured the crop, particularly the first nine experiments. Experiment 3, is intended to test action of soluble phosphoric acid. Experiment 4, to test reduced phosphoric acid. Since one pound of lime was used to reduce Number 4, and fearing this lime might be a factor in the solution of the problem, it was added to Number 3, also. Here it was sprinkled on the row after the dissolved bones was thoroughly covered. Not knowing how far the gypsum in the dissolved bones might influence the result of Number 3, Number 5 was added to decide this question.

The raw phosphate and the floats and ash element, were the gift of the generous house of William C. Bee & Co., of Charleston, South Carolina, the agents of Etiwan Dissolved Bone. The ashes of cotton seed hulls were donated by George O. Baker & Co., of Selma, Alabama. The bones used in Experiment 15 and 16, were reduced according to formula herewith given (see page 87) and was a great success.

No. of Experiment.	1t Picking, Sept. 7th.	2nd Picking, Sept. 15th.	3rd Picking, Sept. 25th.	4th Picking, Nov. 2nd.	Total.	Total per acre.
1	.5 lbs.	.5 lbs.	1.1 lbs.	1.2 lbs.	3.3 lbs.	165 lbs.
2	1	1.5	1.1	1.03	4.63	231.5
3	1	5	.88	1.4	8.28	414
4	1 5	3	.84	1.4	6.74	337
5	1	2	1 03	1.35	5.38	269
6	1.5	3	.5	.91	5.91	295.5
7	2.5	3	.81	.7	7.01	350.5
8	.5	2	.35	.84	3.67	184.5
9	.5	3	.77	.97	5.24	262
10	.5	4	1.1	.91	6.51	325.5
11	1.5	4	1.75	1.3	8.55	427.5
12	1	2	1.33	.56	4.89	244.5
13	2	3	1.1	1	7.1	355
14	1	3	1.1	.66	5.76	288
15	1.5	3.25	1.36	1.56	7.17	358.5
16	1	4	1.38	1.4	7.78	389

REMARKS.

Unmanured gave 165 pounds to the acre.

Cotton Seed Meal 231.5 pounds to the acre, excess due to C. S. Meal 66.5 pounds.

C. S. Meal and Soluble Phosphoric Acid 414 pounds to the acre, excess due to Soluble Phosphoric Acid, 182.5 pounds.

C. S. Meal and Reduced Phosphoric Acid 337 pounds to the acre, excess due to Reduced Phosphoric Acid 106 pounds.

C. S. Meal and Gypsum 269 pounds to the acre, excess due to Gypsum 38 pounds.

C. S. Meal and Floats 295.5 pounds to the acre, excess due to Insoluble Phosphoric Acid 64 pounds.

C. S. Meal and Raw Phosphate 350.5 pounds to the acre, excess due to Insoluble Phosphoric Acid 119.0 pounds.

Raw Phosphate alone 184.5 pounds to the acre, excess due to Inshluble Phosphoric Acid 19.5 pounds.

Ash Element 262 pounds to the acre, excess due to Ash Element 97 pounds.

C. S. Meal and Ash Element 325.5 pounds to the acre, excess due to Ash Element 63.5 pounds.

C. S. Meal and Hull Ashes 427.5 pounds to the acre, excess due to Hull Ashes 196.0 pounds.

C. S. Meal and F. G. Bone 244.5 pounds to the acre, excess due to F. G. Bone 13.0 pounds.

C. S. Meal and M. Bone 355 pounds to the acre, excess due to M. Bone 124.5 pounds.

C. S. Meal and C. Bone 288 pounds to the acre, excess due to C. Bone 56.5 pounds.

C. S. Meal and Reduced Bones 358.5 pounds to the acre, excess due to Reduced Bones 127.0 pounds.

Reduced Bones alone 389 pounds to the acre, excess due to Reduced Bones 224 pounds.

The above shows as a whole very unsatisfactory results—due partly to the rust which injured parts of the plat more than others.

EXPERIMENTS IN VARIETIES OF COTTON.

Small quantities of twelve varieties of improved cotton were obtained and planted, side by side, for inspection of habits and characteristics. One row, seventy yards long, was given to each variety, manured at rate of two hundred pounds to acre of equal parts of cotton seed meal and dissolved bone. These were planted April 21st, 1882. Two other varieties received later were planted in another place on May 23d, 1882.

IN EXPERIMENTAL PATCH.

Row No. 1—Planted with McKinnon's Herlong.
2— " " Jones' "
3— " " Cheatham.
4— " " Dixon.
5— " " Jones' Early.
6— " " Jones' Improved.
7— " " Webb's Storm-proof.
8— " " Jowers'.
9— " " Harwell & Smith.
10— " " Baker's Rameses.
11— " " Zellner's.
12— " " Common cotton.

ON COLLEGE FARM.

Row No. 13—Planted with Webb's Champion Prolific.
14— " " Harris cotton.

The stands of some were defective, and though the pickings were carefully weighed, they are not given to the public, for fear of doing an injustice to some by comparisons. Several of these are very fine, and well worthy of the high reputation they have obtained.

In addition to above, a peck of Webb's storm-proof cotton, donated by Mr. W. T. Webb, Alpine, Talladega county, Alabama, was planted and well manured. Mr. Webb claims for this cotton that forty bolls will weigh a pound. This claim was sustained by several weighings. On October 6th forty bolls, which weighed a pound, were carefully separated into lint and seed, and each weighed. The lint was 36.93 per cent.; seed 63.07 per cent.

Forty bolls of each of the fourteen vorieties were selected and weighed, with results varying from six and one-half ounces to one pound. I found from these experiments—of which over fifty were made in one day—that in same varieties of cotton the weights of forty bolls varied greatly—in one variety from six and three-quarter ounces to twelve and a half ounces. The average of all my weighings was between seven and eight ounces.

EXPERIMENTS IN BOXES.

Last winter at our request Mr. J. J. Sykes, of Courtland, Alabama, prepared and sent to college three barrels of the typical soils of the Tennessee Valley of North Alabama. They were selected with great care to represent the virgin soil, the ordinary soil, and the worn-out soil. At same time Mr. Jesse Jones, of Montgomery county, Alabama, sent us four barrels of the typical soils of the prairie belt, representing the black prairie, red prairie, the black hammock, and sandy hammock. Both of these gentlemen have taken the degree of Bachelor of Scientific Agriculture in this College, and are now engaged in successful farming. These soils were selected because they represented the two eminently agricultural regions of the State. Boxes of suitable sizes were prepared and divided into seven series, and following experiments, with results, made:

SERIES I.

Virgin Soil of North Alabama.

Seven boxes, with 40 lbs. in each box.				Results.
No. 1	Unmanured			accidentally killed.
2	3	grammes	nitrate soda	2 bolls weighing 115 grs.
3	6	“	superphosphate	4 “ “ 251
4	3	“	muriate potash	4 “ “ 234
5	3 6	“ “	nitrate soda and superphosphate	killed.
6	3 6 3	“ “ “	nitrate soda, superphosphate muriate potash	6 bolls “ 308 1 rudimentary boll.
7	6	“	cotton seed meal	6 bolls. 244 grs. 2 rudimentary bolls.

Each box received five seed of Herlong cotton on March 31st; came up at once; one stalk left in each box; picked on 10th October.

SERIES II.

Partly-worn Soil of North Alabama.

7 boxes with 44 lbs. soil in each box.				Results.	Weighing.
No. 1	Unmanured			1 boll,	60 grs.
2	3	grammes	nitrate soda	3 “	90
3	6	“	superphosphate	1 “	61
4	3	“	muriate potash	2 “	120
5	3 6	“ “	nitrate soda superphosphate	1 “	82
6	3 6 3	“ “ “	nitrate soda superphosphate muriate potash	2 “	130
7	6	“	cotton seed meal	3 “	130

Each box received five seed Jone’s improved cotton, March 31st; came up at once; one stalk left in each box; picked on October 10th.

SERIES III.

Worn-out Soil of North Alabama.

	5 boxes with 50 lbs. soil in each.	Results.	Weights.
No. 1	Unmanured	1 boll,	72 grs.
2	3 grammes nitrate soda	2 "	171
3	6 " superphosphate	1 "	75
4	3 " nitrate soda	3 "	245
	6 " superphosphate		
5	3 " nitrate soda	3 "	145
	6 " superphosphate		
	3 " muriate potash		

Each box received five seed Jones' early cotton, March 31st came up at once; one stalk left in each box; picked on October 10th.

SERIES IV.

Black Prairie Soil of Montgomery County.

	6 jars with 40 lbs. soil in each.	Results.	Weights.
No. 1	Unmanured	2 bolls,	53 grs.
2	3 grammes nitrate soda	1 "	64
3	6 " superphosphates	2 "	81
4	3 " nitrate soda	Died June 9, and replant'd; 1 large green boll Oct. 10.	
	6 " superphosphate		
5	6 " nitrate soda	1 boll,	51 grs.
	6 " superphosphate		
	3 " muriate potash		
6	6 " cotton seed meal	1 "	74

Planted 12th April with Webb's storm-proof cotton.

SERIES V.

Soil of Montgomery County.

Six jars with 50 pounds soil in each, manured as Series IV.

	Results.	Weights.
No. 1	3 bolls, 1 rudimentary boll,	125 grs.
2	3 bolls, 1 rudimentary boll,	165
3	3 bolls,	125
4	3 bolls, 1 rudimentary boll,	148
5	4 bolls, 1 rudimentary boll,	165
6	3 bolls,	185

Planted 12th April with Baker's Rameses cotton.

SERIES VI.

Soil of Montgomery County.

Six jars with 50 pounds soil in each, manured as Series IV.

	Results.	Weights.
No. 1	1 boll,	50 grs.
2	2 "	57
3	2 "	114
4	1 "	70
5	1 "	35
6	1 "	74

Planted 12th April with Cheatham cotton.

SERIES VII.

Sandy Hammock Soil.

Four jars with 50 pounds each, manured as Series IV.

	Results.	Weights.
No. 1	1 boll,	85 grs.
2	2 "	300
3	2 "	104
4	Died, and replanted June 16; one green boll October 10th.	

Planted April 12th with Dixon cotton.

The last four series were treated as first three. The results are not such as were expected, and have given no definite conclusions as to the wants of the soils. These experiments will, however, be repeated next year, and we hope in next report to be able to give analyses of each soil along with experiments.

RECENT PROGRESS IN AGRICULTURE.

SEED CORN.

Dr. Lewis E. Sturdevant, director of Experimental Station, Geneva, New York, has just given in Bulletin No. 13 some remarkable results of experiments in planting an ear of corn with each circle of grains around the cobb, so as to test the comparative value of the product from tips, central grains, and from butt of the ear. The results are "unexpected and surprising." He found that well developed grains on tips of ears filled out to the end, produced best results, both in length of ear and quantity of merchantable corn. The grains from butt came next in value, and the central grains, commonly used for seed to the exclusion of the others, made the poorest product. These phenomena were so marked as to be incontrovertible. Ears well developed to the end only were used.

FIXATION OF AMMONIA.

It has long been known that gypsum has power of fixing the volatile salts of ammonia, and has been largely used for compost heaps and in stables for this purpose. Mr. Baye has recently experimented with other salts for same purpose, and has found this power to be possessed by kainit (German potash salts,) and kieserite (sulphate magnesia.) It seems quite probable that the chief benefits to be derived from use of gypsum and potash salts lie in this fixing power.

SORGHUM AND SUGAR CANE SYRUPS.

Repeated analyses made by Prof. Collier of Agricultural Department Washington, upon sorghum in its various stages of development, have shown that the cane should fully mature its seed and remain as much longer thereafter as possible in order to give the maximun amount of sugar or syrup. By allowing the plant to remain five weeks after seed were in the dough, five per cent. more sugar was obtained. He therefore advises not to cut the cane until ready to grind and not to grind until sometime after seed matures.

Another fact is worthy of farmer's attention since sorghum and cane growing is on increase in our State. To make a pure syrup below the granulating point, a saccharometer (a cheap instrument to be had of any large druggist, costing $1.25) should show ⅔ sugar or 66⅔ per cent. while hot (and boiling point of 239 degrees Fahreneit)=72½ per cent. when cold.

For sugar, carry to 76 per cent. while hot (or boiling point 242 degrees Fahrenheit=83.6 per cent when cold. At this point there will be 12 per cent. water, 76 per cent. pure sugar and 12 per cent. inverted sugar.

ATMOSPHERIC NITROGEN.

[The following are the concluding pages of the elaborate report on the "Rain and Drainage Waters at Rothamsted," in the current number of the *Journal* of the Royal Agricultural Society, by Sir J. B. Lawes, LL.D., F.R.S., F.C.S.; and J. H. Gilbert, M.D., F.R.S., F.C.S.; and R. Warington, F.C.S.]

SUMMARY.

AMOUNT AND COMPOSITION OF RAINFALL.

1. The rainfall at Rothamsted during twenty-eight years, 1853–80, has varied from 18.56 inches in 1864 to 36.04 inches in 1870, the average being 28.30 inches.

2. Determinations of ammonia at Rothamsted in the rain of 1853–4 showed an average of 0.74 nitrogen per 1,000,000; determinations by Way (1855 and 1856), 0.88 and 1.18 nitrogen per 1,000,000. Frankland's determinations in 1869-70 showed 0.37 per 1,000,000. Determinations made quite recently at Rothamsted confirm Frankland's results; the earlier figures are probably too high.

3. The total nitrogen supplied in the annual rainfall at Rothamsted is probably 4 to 5 lbs. per acre, excluding the condensation by the soil. The mean of continental estimates, including localities near towns, is 10.23 lb. per acre.

4. The chlorine in Rothamsted rain has averaged 13.42 lb., equal to 22.12 lb. pure common salt per acre per annum. At Cirencester the amount is equal to 53.66 lbs. of salt.

DRAINAGE WATER FROM LAND UMANURED AND UNCROPPED.

5. The annual drainage during ten years, 1870–1 to 1879–80, from three drain gauges, of heavy loam with clay subsoil in natural condition of consolidation, 20, 40 and 60 inches deep has varied from 4.97 to 25.86 inches, mean 13.49 inches, or 21.7, 60.5, and 43.4 per cent. of the rainfall.

6. The evaporation from the bare soil averaged 5.58 inches

from October to March, and 11.97 inches from April to September, total 17.55 inches. The evaporation during the summer and whole year is a fairly constant quantity with great difference of rainfall.

7. The evaporation from a cropped soil is far more considerable, and very variable.

8. Nitrates are largely produced in soil by the action of a living ferment on the nitrogenous organic matter and ammonia; nitrification takes place chiefly in the upper layer of soil, and is greatly favored by the presence of water, and by summer temperature. The waters from the drain gauges are richest in nitrates in late summer and autumn, and poorest in spring.

9. The quantity of nitrogen as nitrates annually removed in the drainage waters (October to September) has varied from 31.78 lb. to 57.95 lb. per acre; the average of four years, 1877–8 to 1880–1, is 41.81 lb., equal to 268 lb. of ordinary nitrate of sodium per acre.

10. The amount of chlorine in the drainage from the drain-gauges is approximately the same as in the rainfall.

11. The advantage of a bare fallow is largely due to the production of nitrates in the soil; in fields in bare fallow at Rothamsted 50 lbs. per acre of nitrogen as nitrates have been found at the end of summer in the first 20 inches. If followed by a wet winter, bare fallow must result in a serious loss of soil nitrogen.

DRAINAGE WATERS FROM LAND MANURED AND CROPPED WITH WHEAT.

12. The drainage-water passing through a natural soil is of two kinds:—1. Surface water passing downwards through open channels. 2. The discharge from the saturated soil. The first is much weaker than the second, save when soluble manures have been recently applied to the surface.

13. The anual average loss of lime and magnesia by drainage from the continuously unmanured wheat plot is apparently about 233 lb.; where 400 lb. ammonium salts are applied, the loss is 389 lb.; where sulphate of sodium, potassium, and magnesium are also added, the loss is still greater, the two last named salts exerting most influence. Nitrate of sodium does not apparently increase the loss of lime.

14. The chlorine and soda applied in manure are retained to only a small extent, either by the wheat crop or the soil; sulphuric acid is retained to a somewhat greater extent. Phosphoric acid and potash are very perfectly retained, the part unassimilated by the crop being held by the soil, chiefly in the upper layers. This is especially true of phosphoric acid.

15. The quantity of nitric acid lost by drainage from unma-

nured land cropped with wheat is far smaller than that lost by uncropped land, the crop assimilating the nitrates formed. In summer the drainage waters contain little or no nitrates; after harvest nitrates reappear, and are found in the waters through the winter.

16. When ammonium salts are applied to land, the ammonia is at first retained by the soil, while the sulphuric acid or chlorine passes into the drainage water, chiefly as calcium salts.

17. The conversion of the ammonia into nitric acid commences almost immediately after the application of ammonium salts to wet soil, the conversion is apparently complete in a few weeks if wet weather follows. The nitrogen of rape cake is more slowly converted into nitric acid.

18. The drainage waters from plots manured with ammonium salts are richest in nitrates shortly after their application. With 400 lb. of ammonium salts per acre applied in March, the April drainage waters have averaged 6.7 lb. of nitrogen (=42.8 lb. nitrate of sodium) per inch of drainage.

19. With an equivalent amount of nitrogen applied at the same time as nitrate of sodium, the April drainage waters have contained 11.18 lb. of nitrogen (=75.6 nitrate of sodium) per inch of drainage.

20. In summer the drainage water from plots receiving 200 to 400 lbs. ammonium salts contain little or no nitrates if phosphates and potash have been supplied; but with an excess of ammonia, or a deficiency of ash constituents, the nitrates produced are imperfectly assimilated by the crop, and appear in the drainage water.

21. In winter time the drainage waters from all the plots tend to approximate in composition.

QUANTITY OF NITROGEN LOST PER ACRE BY DRAINAGE.

22. Taking the average of two seasons of excessive drainage, but for which we have analyses of every running from the drain pipes in the experimental wheat field, it was estimated that from 15 to 17 lb. of nitrogen were lost per acre per annum by drainage from plots which had received no nitrogenous manure for many years. Nearly the whole of this loss occurred during the period of the year when there was either no crop on the ground or but little growth.

23. With 44, 88, and 132 lb. nitrogen applied as ammonium salts in the spring, the estimated loss by drainage was 22, 28, and 42 lb. of nitrogen per acre per annum. With 88 lb. of nitrogen applied as ammonium salts, without or with different mineral manures, the loss ranged from 28 lb. with the most liberal mineral

manure, to 50 lbs. without any mineral manure for many years. The loss was the greater, the greater the deficiency of available potash and phosphoric acid in the soil. With nitrate of sodium, spring sown, the loss was greater than with ammonium salts; but it was greater still with ammonium salts, autumn sown.

24. Reckoned over thirty years, with much better average seasons, the estimated loss by drainage was from 10 to 12 lbs. of nitrogen per acre per annum, without any nitrogenous manure. With 43, 86, and 129 lbs. nitrogen applied as ammonium salts, in most years autumn-sown, the estimated loss was 19, 31, and 42.4 lbs.; and with 86 lbs. nitrogen applied, without or with different mineral manures, the estimated loss ranged from 31 lbs. with the most liberal mineral manure, to 43.2 with the ammonium salts continuously used alone.

25. Reckoned over thirty years, not quite one-third of the nitrogen supplied by manure was recovered in the increase of crop under favorable conditions as to mineral manure and growth, and very much less when there was a deficiency of potash and phosphoric acid, and defective growth accordingly.

26. With 400 lbs. of ammonium salts, and the most liberal mineral manure, there was the maximum amount of nitrogen recovered in the crop, and the minimum amount in the drainage; but with the ammonium salts used alone, there was the minimum amount in the crop, and the maximum amount in the drainage.

27. Only with the smallest quantity of ammonia applied was the amount of nitrogen in the total crop and drainage together, more than was supplied in the manure; in all other cases there was a greater or less deficiency. Besides the nitrogen supplied in manure (which was not entirely recovered in the crop and drainage), it is estimated that on the average about 30 lbs. would be contributed per acre per annum by the soil and by rain, and condensation of combined nitrogen from the atmosphere; perhaps more by the soil in the earlier than in the later years.

38. Analyses of the soils of the different plots, made at different periods, show that the amount of nitrogen was considerably reduced where no nitrogenous manure was applied; but where nitrogenous manures were applied, the amount remained stationary or slightly increased or diminished, according to the condition of the soil as to mineral constituents, and to the amount of growth. In fact, the difference in the amount of nitrogen in the soils of the plots with ammonia applied, compared with that where none was applied, bore a close relation to the amount of growth, and was mainly due to the residue of the crops.

29. The amount of nitrogen in the crops, and estimated to be lost in the drainage, together with the excess in the soil where it was supplied in manure, is not sufficient to account for the whole

of that so applied, and that available from other sources; but there is evidence that, reckoned according to the composition of the collected drainage waters, the estimates of the loss of nitrogen by drainage are too low.

30. When farmyard manure is largely used, there is sometimes considerable loss of nitrogen, due to the decomposition of nitrogenous organic matter, and the evolution of free nitrogen; or when the soil is saturated with water, or imperfectly aerated, there may be destruction of nitric acid and evolution of free nitrogen. It is believed that, under the conditions of the artificially manured plots in the experimental wheat field, there would eb very little loss from either of these sources, and that the loss is almost exclusively drainage.

31. In ordinary agriculture, with a larger proportion of the nitrogen supplied in farmyard manure or animal manures, with ammonia or nitrate used in smaller quantities, and with a variety of crops covering the ground with vegetation for longer periods of the year, the loss of nitrogen per acre by drainage will be considerably less than it has been shown to be in the experimental wheat field.

PRACTICAL CONCLUSIONS.

1. Most of the nitrogen of farm crops is derived from the nitric acid of nitrates within the soil.

2. The nitric acid in the soil is produced from the nitrogenous compounds of the soil itself, from the nitrogenous organic matter of animal and vegetable manures, from the ammonia of artificial manures, and from the ammonia supplied by rain and condensation from the atmosphere. A very small quantity of ready-formed nitric acid is supplied by rain and condensation from the atmosphere. Nitric acid is also provided by the direct application of nitrates.

3. The ammonia of ammonium salts is rapidly converted into nitric acid in the soil, as also is the nitrogen of some organic matters, such as urine. The nitrogen of rape cake, that of the less soluble parts of farmyard manure, of stubble, of roots, &c., is much more gradually converted into nitric acid, and it may require many years for the conversion of the whole of it. The nitrogenous compounds of the soil itself are very slowly converted into nitric acid, but the soil yields a certain quantity every year.

4. When there is no vegetation, and there is drainage from the land, or even when there is vegetation and excess of drainage, nitric acid is lost by drainage.

5. As in the case of permanent grass land the soil is always covered with vegetation, there will be with it the maximum

amount of nitric acid utilized by the crop, and the minimum amount lost by drainage. Land without vegetation will be subject to the maximum loss of nitric acid by drainage.

6. The power of a growing crop to utilize the nitric acid in the soil is much diminished if there be a deficiency of available mineral constituents, and especially of potash and phosphoric acid, within the reach of the roots.

7. As the various crops grown upon a farm differ very much as to the period of the year of their most active growth, the length of time they remain on the land, and the character and the range of their roots, their capacity for taking up nitric acid from the soil is very different.

8. The recognized exhausting character of corn crops is largely due to the limited season of their active growth, and the long period during which the land is bare, or there is little growth, and so subject to loss of nitric acid by drainage.

9. When salts of ammonium, or nitrates, are applied as manure, the chief, if not the only unexhausted residue of nitrogen left within the soil available for future crops, is that in the increased roots and other residues of the crops; and this only slowly available.

10. When oilcakes or other foods are consumed by stock, the formation of nitric acid from the manure produced is slower, but continues longer than when salts of ammonium are used. When there is a liberal use of animal manures, an accumulation of nitrogenous and mineral matter takes place in the soil, and such accumulation is known under the term "condition." Under such circumstances the fertility of the soil is maintained, or it may be considerably increased.

USEFUL FORMULÆ.

The following are inserted to meet the large demand made by farmers throughout the State, upon this Department:

COMPOST.

Many letters have been received by our Department of Agriculture for a formula for composting cotton seed, stable manure and dissolved bone. We here append one that has been used with great success on the red lands of Alabama and Georgia. For both corn and cotton, take 100 bushels cotton seed, 100 bushels stable manure, and one ton of dissolved bone—select a level place under shelter—spread out ten bushels of stable manure to depth of three inches. Upon this, sprinkle evenly 100 pounds dissolved bone. Upon this, spread ten bushels of cotton seed, made thoroughly wet, and over them again sprinkle 100 pounds dissolved bone. Continue the rotation till your quantities are exhausted, and then cover with a layer of rich earth, five or six inches deep. Allow it to remain till ready for use, (four to six weeks will do), and cut vertically down and mix well. For cotton, apply from ten to twenty bushels to acre in drill and bed on it. For corn, a large handful beside the hill. Be cautious in wetting thoroughly your cotton seed, and buying a first-class dissolved bone.

BONES—HOW TO USE THEM.

Bones, when burnt, lose about thirty per cent. of organic matter containing much ammonia. It is, therefore, a waste of a valuable fertilizing ingredient to burn tbem. But whole bones are very hard to pulverize, and without pulverization, are difficult to reduce. Hence, the loss of ammonia is often suffered in order to more speedily obtain the use of the bone. To reduce bones with sulphuric acid, is a tedious, troublesome, and expensive job to the individual planter; hence, he must resort to some other way of making them soluble. The following is prescribad by a high authority, and we recommend it to every farmer who has a few hundred pounds of old bones on his plantation:

Break 100 pounds of bones into small fragments, and pack them in a light cask, with 100 pounds of good wood ashes which have been previously mixed with twenty-five pounds of dry water slaked lime, and twelve pounds of powdered "sal soda," ("washing soda.") Twenty gallons of water will saturate the mass, and more may be added as required. In two or three weeks the bones will be soft enough to turn out on a floor and mixed with two bushels of good soil.

In this way we may save many a dollar now spent in buying commercial fertilizers.

AGRICULTURAL MUSEUM.

A large room twenty-five by forty, assigned me by President of College, has been fitted up with necessary shelves and tables. Suitable glassware was made to order by Messrs. Whitall, Tatum & Co. of New York.

Collections of the various Agricultural products have been made, classified, labelled, catalogued and shelved. From numerous private sources contributions have been received, but our chief supply was obtained from the International Cotton Exposition held recently at Atlanta, Ga. While on a visit to this exposition in December, arrangements were made to secure quite a number of products, then on exhibit, at its close, January 1st,

1882. Accordingly, on 30th December '81, Cadet Harp was dispatched to Atlanta and commissioned to collect, whatever he could, suitable for our Museum. His energy, aided by the generosity and courtesy of several exhibitors, secured for us a very large collection both in quantity and kinds. Through the courtesy of Director General Kimball samples of all the foreign cottons on exhibition were obtained. We are also indebted to the States of Kansas, South Carolina and Florida, to several Railroad Companies and to many private exhibitors for valuable donations. To all we wish to return the thanks of the College and the personal obligations of the writer. Further arrangements have been made for increasing the Museum by exchange, through the departments of Agriculture in the Agricultural and Mechanical colleges of the North and West.

Since the above was written, large donations have been made to the Museum by the well known seed houses of Landreth & Son Philadelphia, Peter Henderson & Co., Thornton & Co., New York City.

Many of our citizens have also generously contributed to the increasing number of our specimens. The Museum now contains over five hundred valuable specimens.

We trust the farmers throughout the State will appreciate this Museum and lend us their aid in increasing its collections. Samples of all kinds of agricultural products, remarkable either for excellence, rarity or adaptability to our soils and climate, are respectfully solicited.

CHEMICAL DEPARTMENT.

A large amouut of Laboratory work has been done in this department during the year just closed both of a private and public nature. Those of a public character consisted of analyses of commercial fertilizers and feeding stuffs.

COMMERCIAL FERTILIZERS.

At opening of the spring of '81 letters were addressed by Colonel Wm. H. Chambers to farmers in various parts of the State, requesting them to draw in person samples of all the Fertilizers sold in their vicinity and forward to him by express. In this way about 40 different brands were received. These samples were taken by him and numbered or labelled (every indication of name or manufacturer being removed), and handed over to Department of Chemistry. This work continued until stopped by illness and death of Col. Chambers. Up to that time, however, 34 brands had been analyzed and reported upon. Had he lived, an accurately printed report of these analyses would have been given to the public. Since his death it has been almost impossible to accurately substitute the names for all the "numbered" brands analyzed, and not wishing to work an injustice to any manufacturer by a misrepresentation of the contents of his wares, it has been deemed prudent to decline publication. Thus a large amount of Laboratory work has been rendered useless.

It is proper here that I should express the obligations due to two of my senior scientific students, Messrs. Acre and Van Hoose, who rendered material aid in these analyses.

Under the head of Commercial Fertilizers may be included two manurial substances, now well known and largely used, Cotton Seed Meal and Cotton Seed Hull Ashes. Analyses of these have been made at different times and from different oil works. They are worthy of a consideration here, since they are home products and growing daily in popular favor.

Two reasons may be given for the future importance of these substances to our farmers. 1st. They are produced in every part of the State, (there being oil mills in Mobile, Montgomery, Selma, Eufaula, Demopolis and Huntsville) and therefore easily accessible to all farmers. 2d. They furnish the valuable ingredients of fertilizers at a price far below their marketable values in the Eastern cities. This rapid multiplication of oil mills will bring their products prominently before the public and induce many farmers to try them, who heretofore have either been ignorant of their existence, or ignored them as fertilizers. The many letters which I have received and answered, in regard to these products warrant the above assertions. Analyses of cotton seed meal from different mills have been made, and from mean of them all we can, without much error, state that it contains

Nitrogen 7 per cent.; Phosphoric Acid 3 per cent.; Potash 2 per cent.

This retails in Montgomery at $20 per ton. If we estimate its value of Nitrogen alone, by Georgia tariff, 18 cents per pound of Ammonia (equal to 22 cents per pound of Nitrogen) we have over $30 as the value of a ton. If we take in consideration its Phosphoric Acid and Potash, its value is still further enhanced. Prof. Johnson, in the report of the Connecticut Agricultural Experiment Station for 1880, puts the average cost of cotton seed meal in Connecticut at $27 50 per ton, and the estimated value from analysis at $36 19, thus makiag the latter exceed the former by 24 per cent. "The trade values used for reckoning the above valuations were 20 cents for Nitrogen, 9 cents for Phosphoric Acid and 4½ cents for Potash." In Nitrates he reckons the Nitrogen at 26 cents per pound; but here he only assigns a value of 20 cents per pound. Our experiments with Nitrogen in form of cotton seed meal show results with but little or no difference from that in form of Nitrate of Soda, and this has been the universal testimony, so far as I have been informed, of all those farmers who have used the two. Hence it would seem reasonable to assign the same commercial value to the Nitrogen in Nitrates and in Cotton Seed Meal. To the farmer the values are thought to be the same. But Prof. Johnson's figures are "trade values," *i. e.* "money value per pound of the ingredients estimated from the market prices of the standard articles which furnish them to commerce," and not agricultural values. Hence, after making the above valuation of cotton seed meal, he has to make a reduction of his trade values so far as this fertilizer is concerned. He therefore places its Nitrogen at 16 cents per pound, Phosphoric Acid 6 cents and Potash 3½ cents, and then obtains as the value of a ton $28 30, which accords with the market value in New Haven. But we are speaking of its agricultural value, and if it can be proven that a pound of Nitrogen in Cotton Seed Meal is equal in effects to a pound of Nitrogen in Nitrate of Soda, then surely to the farmer it has the same money value. The latter commands readily 25 cents cash in our eastern markets, and is largely bought to "ammoniate" the superphosphates which are sold in Georgia and Alabama. In selling these superphosphates to the planter on time, their cash valuation is first estimated by affixing the above price to the Nitrogen it contains and then a certain per cent. is added for time (a large one usually.) So that bv the time the Nitrogen of Nitrates found in our fertilizers reach the consumer, the costs often exceeds 30 cents per pound. When cotton seed meal can be obtained by the farmer for $20 00 per ton, the Nitrogen (if we allow 9 cents for Phosphoric Acid and 4½ cents for Potash) is obtained at the astonishingly low figure of 9 cents per pound. If we put Phosphoric Acid at 6 cents and Potash at 3½, then Nitrogen is 10¾ cents nearly per pound. This is sufficient to show the farmer that a home product, which he has heretofore ignored, furnishes him with the cheapest Nitrogen, and perhaps in an as available form as any other. If then he wants to make an ammoniated superphosphate equal to the best fertilizer on our market, let him try a high grade Acid Phosphate and mix it with Cotton Seed Meal.

COTTON SEED HULL ASHES.

The following letter in response to an inquiry relative to the above, will probably explain all that is desired under this head:

ALABAMA AGRICULTURAL AND MECHANICAL COLLEGE,
AUBURN, ALA., JANUARY 18TH, 1882.

Mr. Geo. G. Duffee, Mobile, Ala.

DEAR SIR: Your letter relative to analysis of Cotton Seed Hull Ashes, and their comparative value with ashes of hard wood, received. Sometime since, a sample of ashes taken from furnace of the oil works in Montgomery, was analyzed with the following results:

Sand and Soluble Silica.........	19.38 per cent.	
Phosphoric Acid..................	9.34 per cent.	@ 9.50 pr. ct.
Potash..............................	15.56 "	@15.68 "

Other substances not separated.

In above, the Phosphoric Acid and Potash, (the only ingredients which give a commercial value to the ash), were determined twice.

Subsequently a sample was sent me from the oil works at Selma, by their President, Geo. O. Baker. A partial analysis of this gave of

Phosphoric Acid..........................	10.75 per cent.
Potash	14.60 do
Sand and Soluble Silica..................	20.23 do

In this latter analysis, of the 14.70 per cent. of potash obtained, 10.70 per cent. was soluble in water. The remainder was soluble in strong acid. The phosphoric acid is always in the insoluble form in all ashes. These are results obtained of the ashes obtained from the furnaces, where cotton seed hulls are mainly used as fuel. Of course, these ashes (as large amount of silica present indicates) are not the pure ash of the hulls. Theoretically, they contain a larger percentage of hoth of these valuable ingredients than are found here. These ashes showed that they were mixed with sand, charcoal, wood ashes, etc.

From these analyses we may assume without much error, that the ashes from cotton seed hulls, as obtained from the furnace, contain of

Phosphoric Acid.....	10 per cent.
Potash	15 per cent.

Of the potash present, 10 per cent. may also be assumed as being readily soluble in water and therefore available to plants. We have no way in Alabama to determine the commercial value of a fertilizer, as we have ~~no~~ laws to regulate the price, quality or sale of commercial fertilizers, and therefore, have to go out of the State to find a tariff by which to estimate the value of a ton of ashes of cotton seed hulls. The Commissioner of Agriculture of Georgia, assigns no value to insoluble phosphoric acid, saying in his report: "Insoluble phosphoric acid is not available as a plant food, especially if derived from phosphate rock, but if derived from animal bone is valuable if immediate results are not desired." Georgia, therefore, does not help us as to the phosphoric acid in our ashes. A value of 6 cents per pound is assigned to potash soluble in water. Prof. Johnson, in his report of Connecticut Experimental Station, values insoluble phosphoric from 3½ cents per pound in fine ground phosphate to 6 cents per pound in fine bone and fish guano. Other chemists have given as average value of insoluble phosphoric acid 4-5 cents. If we take 5 cents per pound as the probable value of our insoluble phosphoric acid and 6 cents per pound for soluble potash, we have in a ton

200 pounds Phosphoric Acid, 5 cents	$10 00
200 pounds Soluble Potash, 6 cents	12 00
Commercial value of ton	$22 00

No value is here given to insoluble potash. If we give to phosphoric acid a value of 4 cents per pound, we will reduce the price per ton to $20. You will see, therefore, that the price charged per ton, $20, by the mills in your city, is not far from the commercial value adopted by some of our States. Common hard wood ashes contain of potash from 6-10 per cent., phosphoric acid 1.50 to 4 per cent. The average of household ashes where hard wood is burnt; is probably not far from 8½ per cent. potash and 5 per cent. phosphoric acid. A bushel will weigh 48 pounds. The value of potash and phosphoric acid remaining as above, a bushel would contain :

4.08 pounds Potash at 6 cents	24:48
.96 pounds Phosphoric Acid at 5 cents	4:80
	29.28 cts.

and would be worth 30 cents per bushel.

Of course valuation of such fertilizers as these are much less exact than commercial fertilizers since they contain more or less of lime, magnesia and sulphuric acid, which are variable in value, according to locality and state of market. If these ashes are well mixed in a compost with vegetable matter before being used, they would probably be more efficacious and speedy in their results. Besides, the vegetable mould which they would assist in forming, would also be of great benefit in a garden.

Yours, truly,
WM. C. STUBBS,
Professor of Chemistry.

FEEDING STUFFS.

In analyses of Feeding Stuffs certain proximate principles are determined, viz: Albuminoids, Carbohydrates, Fat, Cellulose and Ash. These not only differ in composition but exert different physiological action. Albuminoids, which are usually ranked as highest in importance, are represented in the egg by albumen, in milk by the casein or curd, and in meats by fibrine. They are useful in animal economy for making muscles, tissues, tendons, nerves, &c., and in the absence of other ingredients may serve as fuel and fat. True Carbohydrates consist of starch, sugar, gum, &c., and their chief function seems to be to furnish heat to the animal system. Fats may produce fat or be consumed as carbohydrates for fuel. Cellulose is for most part indigestible, and therefore takes no part in animal nutrition. When a part of it is digestible its action is similar to carbohydrates. The following, taken from Prof. S. W. Johnson's Report, will assist in giving a clear idea of the functions of these ingredients:

"The Carbohydrates cannot restore the worn out muscles or membranes of the animal any more than coal can be made to renew the used up packing, bolts, valves, flues and gearing of a steam engine. The Albuminoids are to the ox or the man what brass and iron are to the machine, the materials of construction and repair.

The Carbohydrates are furthermore to the animal very much what coal and fuel are to the steam engine. Their consumption generates the power which runs the engine. Their burning (oxidation) in the blood of the animals produces the results of life just as the combustion of coal in the fireplace of the steam engine produces the motion and power of that machine.

There is, however, this difference between the engine and the animal. The former may be stopped for repairs, the latter may run at a lower rate, but if it be stopped it cannot resume work. Hence the repairs of the animal must go on simultaneously with its wastes. Therefore, the material of which it is built must admit of constant replacement, and the dust and shreds of its wear and tear must admit of escape without impeding action. The animal body is as if an engine were fed with coal and water not only, but with iron, brass and all the other materials for its repair, and also is as if the engine consumed its own worn-out parts, voiding them as ashes or as gas and smoke. The albuminoids, or blood and tissue formers, are thus consumed in the animal as well as the carbohydrates or fuel proper. The fact that the albuminoids admit of consumption implies that when the carbohydrates, or proper fuel are insufficient, they, the albuminoids, may themselves serve as fuel. Such is the case, in fact. But, nevertheless, the two classes of substances have distinct offices in animal nutrition, and experience has demonstrated that for each special case of animal nutrition a special ratio of digestible albuminoids to digestible carbohydrates is the best and most economical, and within certain limits is necessary. This proposition we designate as the *nutritive ratio*, and these explanations make its significance evident."

But not all of the nutrients present in fodder are digestible. Actual feeding experiments upon different animals are necessary to determine the percentages of albuminoids, carbohydrates, fat, &c., in a food which is digestible. This has been the work of some experimental stations in Germany for several years, and nearly all that is known in regard to animal nutrition is the result of experiments there conducted. A recent work, entitled "A Manual of Cattle Feeding," by Dr. Armsby, furnishes a compilation of the results of these experiments, together with much valuable information in regard to composition and use of the various feeding stuffs. In this book we find that from German experiments the following values have been given:

1 pound of digestible albuminoid	4⅛ cents.
1 " " fat	4½ "
1 " " carbohydrates	9-10 "

The following proximate analyses have been made: Cotton seed, cane leaves and chicken corn, or "durra:."

COTTON SEED.

This substance has long been used as a winter food for cattle and sheep in the South, often alone, sometimes with coarse hay or fodder. The ration used depended upon the will of the feeder —sometimes a peck or more being given at a feed. It has long been known that the cotton seed was rich in oil and albuminoids, but what proportion the latter bore to the carbohydrates, was to me an inviting question, which was not answered satisfactorily by any authority at my command. Deeming this question worthy of solution, and with a view of thrrowing some practical light upon the proper feeding to our stock, I gave them an analysis with the following result:

Albuminoids	17.20	per cent.
Carbohydrates	15.00	" "
Cellulose	39.68	" "
Fat	24.86	" "
Ash	3.26	" "
	100.00	

No experiments have been made that we can find for determining the digestibility of the different ingredients in cotton seed. The results of experiments with cotton seed cake gave 74 per cent. of albuminoids, 91 per cent. of fat, and 44 per cent. of carbohydrates as digestible. Nearly all the albuminoids of the seed is contained in the kernel, and the latter, after the oil is expressed, constitutes the cake and since digestibility of cotton seed cake is constant, regardless of coarse fodder used, we may, without serious error, assume that 74 per cent. of albuminoids of cotton seed are digestible. Since seed contains so much fat, by far more than enough to meet the ordinary requirements, as established by Wolffe, we could not with certainty apply the coefficient found for the meal above. The same may be said about the carbohydrates—therefore we are unable to determine accurately its nutritive ratio. The hull of the seed is pronounced by Dr. Voelcker, of England, as "possessing no feeding value, but contains an astringent principle useful to cattle on rough pasture or succulent food, which prevents scouring." The same authority says it should never be given to calves. Regarding the hull as entirely indigestible, and assuming the digestive coefficient as equal to those of cotton seed meal, we would have as nutritive ratio 12.72: 63.45, or 15. (Here fat is counted as 2½ pounds carbohydrates, and the digestible cellulose in the kernel is omitted.) The nutritive ratio for a milch cow is 1:5.4. But we know that cotton seed alone are not recommended for milch cows. Indeed, we have made the mistake of estimating 91 per cent. of oil as digestible, when it is an established fact that foods "containing much fat are difficult of digestion by herbivorous animals, and an undue amount of them is liable to produce injurious effects." This coincides with the experience of many farmers who have witnessed the injurious effects of an overfeed of cotton seed to their milch cows. Hence the digestive coefficient of fat in cotton seed, and therefore the nutritive ratio is still uncertain and remains to be determined by direct experiment.

The same difficulty is encountered if we try to combine cotton seed with other feed to form a perfect ration. A cow weighing 1000 pounds is said to require daily of digestible nutrients—2½ lbs. albuminoids, 12.5 lbs. carbohydrates, and .4 lb of fat. Here, if we regard 91 per cent. of fat of seed as digestible, 1½ lbs. of cotton seed will nearly furnish this. Hence, in combining it with coarse fodder to obtain the necessary albuminoids, we carry the fat to such an excess as perhaps to produce injurious effects. To properly combine it, we should use some other food with our coarse fodder to increase the albuminoids, and just enough of cotton seed to furnish the desired fat. In this way the latter is reduced to such homoepathic doses as to impress many of our farmers with the insignificance of these rations. If the hulls are entirely useless and the surplus of oil prevents the use of so large a ration as the albuminoids require, then it is plain that the best disposition to make of our seed is to ship them to the nearest mills and have their hulls and oil removed and feed the residue as

COTTON SEED MEAL.

whose composition is, according to Professor Johnson,

Water	8.87
Ash	6.99
Albuminoids	45.00
Cellulose	4.65
Carbohydrates	22.89
Fat	11.60

And the digestible nutrients in air-dry substance, according to the same authority, calculated upon the German coefficients of digestibility given above, are

Albuminoids	33.30	per cent.
Carbohydrates	11.60	" "
Nutritive rations	1:1.1	

Estimated value, by tables given above, for one hundred pounds is $2.00.

The same authority says: "The feeding experiments from which the digestibility of cotton seed meal was deduced, were made with a very impure and inferior Egyptian meal, and it is probable that the digestibility of the pure meal is greater. If that be the fact, then the above estimated value is relatively too low. Either as a fertilizer or as cattle food, cotton seed meal is one of the cheapest articles in the market and deserves to be used to a much greater extent than it now is. By employing it fresh in the feeding trough, its fat and carbohydrates are utilized to the best advantage. Thence a large share of its nitrogen, its phosphates and potash pass into and enrich the manure."

The use of cotton seed meal as a food is very limited in the South, notwithstanding its market value is not but one-half of its nutritive value, as determined above. This arises, doubtless, from the lack of system in feeding cattle, and when experiments have been made with it, this meal has often been used as the main food and not as an adjunct to other and coarser foods. Large quantities, like cotton seed, are injurious, and hence, unless properly experimented with, this meal is apt to give great dissatisfaction to the farmer. Dr. Voelcker says, "it should be used judiciously mixed with other meals." A practical dairyman of large experience in its use, gives as a daily ration far a milch cow four quarts of cotton seed meal and four quarts of corn meal with coarse hay.

The chief markets for the large quantity of cotton seed meal now made in the South are Great Britain and the North. The former country is said to import annually over $8,000,000 worth. The London Agricultural Gazette styles it "the most valuable feeding stuff imported," and by its free use English graziers can successfully compete with the American.

The North is consuming large and increasing quantities of it yearly, and the large amount of literature in regard to its value and use, in the agricultural and other journals, attest the high estimation in which it is held. One of the most influential of the New York dailies, after noticing the injurious effects of exporting cotton seed meal, and the still more ruinous habit of allowing so much cotton seed to go to waste, closes with the following: "The waste of rural wealth in this one article represents a sum that would astonish the best informed farmers of the country. It is a waste—one of a numerous class—that has millions in it."

I am often asked the best method of utilizing cotton seed. When not convenient to oil mills, I have invariably recommended to compost according to formula on page.

If you are convenient to an oil mill, your seed should be crushed, oil expressed, hulls returned to compost heap, and the cake or meal fed to farm animals and the manure from the latter carefully preserved. Careful analyses by Voelcker and experiments by Lawes have demonstrated that the manure from one ton of cotton seed meal is worth more as a fertilizer than the meal itself. In its passage through the animal, it fully subserves all the purposes of nutrition, without recovering any of fertilizing ingredients. The latter are left in the manure in a condition better adapted for plant food than they were in the meal. Should our legislature enact a wise stock law, this would have a strong tendency to improve all our stock, and with improved stock would come improved methods of feeding and caring for them. Then cotton seed meal would find its true place in our agricultural economy and the South its true position in National Agriculture, for then we would grow fine cattle, sheep, hogs and horses upon our own products, instead of furnishing the latter to the North and England as we are doing, for same purposes.

Again a " Plantation Oil Mill " has been recently offered to the public at a comparatively low price, capable of using three tons of seed per day. This mill is manufactured by McGowan Pump Co. of Cincinnati, Ohio and consists of four parts—the huller, crusher, steamer, and press, an eight horse engine is required to work it. A committee appointed by National Cotton Planters Association at its late meeting in Little Rock, Arkansas, reported favorably upon it. With the use of one of these mills in every neighborhood, there is no reason why the income derived from cotton seed may not be largely enhanced. The oil in the seed is positively objectionable to the latter, either for feeding or fertilizing purpose. When removed, the oil constitutes an important article of our national commerce, greatly increasing our wealth, when used as fertilizer or feed, this immense wealth is *lost*. We believe these plantation oil mills will revolutionize our present habits in regard to loses of cotton seed. When they are established in every community and every bushel of seed, save what is left for planting is properly utilized what an immense wealth will be added to our country. Examine alone for Alabama. The State of Alabama, it is thought will grow the present year 700,000 bales of cotton of five hundred lbs. each upon 2,325,000 acres. This would afford 340,000 tons of seed. Reserving fifty lbs. of seed per acre 58,125 tons for planting purposes, we will have 291,875 tons for the oil works. What are the products from manipulating these with oil mills? If linters are used, each ton of seed will give 22 lbs. of short staple cotton, excellent for batting &c., worth about 8 cents per lb. Every ton of seed will give 1,000 lbs. of hulls, 700 lbs. of cake and 26 galons of oil. The hulls are worth $2.00 per ton, if burnt into ashes each ton of hulls gives 140 lbs. of ashes, and latter are worth $20 per ton. The cake in meal is worth $20 per ton and the oil 44 cents. Putting these figures together we have

291,875 tons of cotton seed yielding:	
6,421,250 lbs. short staple cotton @ 8 cts.	$ 513,700.
145,987 tons hulls @ $2	291,875.
102,152 tons meal @ $20	2,043.040.
10,507,500 gallons of oil @ 44 cts.	4,623,300.
Total	$ 7,471,915.
Deduct present value of	
291,875 tons cotton seed @ $10	2,918,875.
Leaving	$ 4,553,165.

as increased value by manipulation in oil mills.

In nearly every oil mill the lint obtained from seed pays the running expenses—deduct this and we have a gain $4,039,455, which is only to be audited by interest on investment and wear and tear of machinery. The value of crude oil exceeds the cost of seed from which it was extracted by $1,704,425. There are now in the South about 75 oil mills in full blast, which consume only about 1-15 of seed raised. Estimating the crop of last year at 6,000,000 bales, we would have 3,000,000 tons of seed—deducting 1-15 as worked up by mills, there was left 2,800,000 tons of seed used as a manure or wasted, representing 100,800,000 gallons of oil at 44 cents—$44,352,000 and 61,600,000 pounds short staple cotton at 8 cents—$4,928,000.

We can safely estimate that if the entire seed were utilized last year, there would have been added to the wealth of the country at least $50,000,000.

In fact we believe the time is near at hand when even a portion of the oil (perhaps one-half) will be given besides hulls and meal. If the "Plantation Oil Mills" are a success and they will consume three tons of seed per day—there will be made daily:

One hundred and eight gallons of oil at 44 per cent	$47.52
One-half for toll	23.76
Leaving	$23.76

As profits for one day (provided a linter is used) multiply this by 300 as the average number of working days and we will have $7,128 per annum as a profit. In manipulation of cotton seed the oil and lint represent clear gains.

If the above can be attained by establishing an oil mill in every neighborhood, who will then say that Mr. Atkinson's assertion at the opening of the Atlanta Exposition, "that the time would soon come when the South would grow cotton for its seed," was an idle extravagant remark.

We have discussed elsewhere the uses of cotton seed meal and hull ashes. The oil has an extensive use in the arts. Refined it is an excellent substitute for lard. Highly refined it is used largely as a salad oil. In crude state it is used as an adulterant of lubricating and linseed oils. Residuum of refined oil is employed in making soap. The oil can be bleached in sunlight and made perfectly white and clear. Refined it is also used as a burning fluid—either alone or mixed with various preparations of refined petroleum oils. When highly refined it is said to exceedingly susceptible to extracts and flavoring essences, and hence an extensive use in the future may be predicted for colognes and perfumes. The French inaugurated the custom of packing sardines in it which is now adopted by other countries. The following from the pen of an accomplished housekeeper, in Rural New Yorker, will show to what uses it is adapted in household economy.

COTTON SEED OIL.

MRS. WM. S. THOMAS.

It is only a few years since both master and servant indignantly denied that cotton seed in any shape was ever used as human food; now the refined oil is as generally used in the cuisine of the rich as in the simple diet of the poor. A year's experience in using it as a substitute for various other fats has given convincing proof that it may take the place of any of them. For frying purposes it is superior, as it does not scorch as quickly as anything else and gives a richer flavor to some things, like Indian meal pancakes. It is exellent for frying fish and doughnuts; the latter do not fat-soak as readily as in lard and the oil left over is even better to use again. I use it altogether to shorten "egg bread," as our Northern Johnny cake is called at the South, and have put it in cream-of-tartar biscuit and plain cake, but I do not like it as well as butter or lard, or when mixed with either. It has a slight flavor of its own that a delicate palate would detect, but which nine people out of ten would not be aware of, and it is not half as disagreeable as the taste of most of our lard, or poor butter. It is an unusual, rather than a disagreeable flavor, and it becomes pleasant by use. The men who work in the mill dip their bread in the oil instead of using butter. For salads it is infinitely superior to any olive oil I have ever tested. The following recipe is popular with us: Heat a jill of vinegar and stir into it three tablespoonfuls of mustard rubbed smooth with a little water or vinegar, take from the fire and add a teaspoonful of sugar, one tablespoonful of oil, one salt spoonful of salt and the beaten yelk of an egg. This dressing will bear being enriched with from four to six tablespoonfuls of oil making it much nicer —a good beating distributes the oil perfectly. If we propose to eat it, the fewer our researches in the matter of lard, the more our composure as consumers, and the same may be said of other greases which enter into our cooking, but nothing can be purer or cleaner than cotton-seed oil as it is manufactured. I have never had any become old or rancid, and those who object to animal fats from principle or prejudice can make it an ample substitute for all of them. A very fine quality of soap is made from this oil, which resembles the best castile. Our can is like a juggler's bottle from which we pour forth liquid for a great variety of uses; from it we fill lamps, a little goes into the starch to keep the irons from sticking; it greases leather, and takes the place of sweet oil in liniments. From its drying qualities when thinly covering exposed surfaces, no doubt it will yet be prepared to use in paints.

In fact, the manufacture of cotton-seed oil seems to be a universal blessing, utilizing what had before been wasted and furnishing a substitute for lard to produce which swine are forced into a state of unnatural fatness that is destroying their constitutions and making them a prey of diseases which unfit them for but does not prevent their becoming human food.

CANE LEAVES.

In November last, on a neighboring creek, some of the leaves of the cane ("arundinaria") which grew on the banks, were subject to analysis with the following results:

Water	28.48
Ash.	6.08
Carbohydrates	24.72
Albuminoids	11.87
Cellulose	25.48
Fat	4.37
	100.00

The only experiment made upon the digestibility of leaves, so far as I am informed, is one on "poplar leaves," at Germany. The digestive coefficients of the nutritive ingredients of "poplar leaves" were very low. Since our plant is unlike the poplar, both in its botanical relations and habits of growth, we cannot compare the two. The above contains rather more albuminoids and fat and less carbohydrates than "poor hay," and in feeding value is but little superior to the latter substance. It will winter stock, and therefore a canebrake is a most valuable addition to every farm; but its composition does not indicate a very high fattening power.

CHICKEN CORN.

In September last a package of this seed was sent to the College for analysis—with the remarks that it was a volunteer growth over much of what is known as the prairies of Alabama; that its yield was enormous, and if found valuable, large quantities could be annually reaped. This is an old acquaintance, which under different names has made its appearance almost regularly every twenty or thirty years. Mr. A. T. Sorsby, of Greene county, Alabama, has the following to say of it in the United States Patent Office Report for 1854, page 160: "I first saw this plant growing in Georgia in 1838. The year following I introduced its culture into this county, where it has been somewhat extensively cultivated since."

The following letter was sent in reply after analysis—which contains all the information which I could give:

ALABAMA AGRICULTURAL AND MECHANICAL COLLEGE,
AUBURN, ALA., November 18, 1881.

Mr. George N. Gilmore,
Morgansville, Lowndes County, Alabama:

MY DEAR SIR: In September last Dr. Tichenor, our president, handed me a package of seed and your letter, with request to analyze and determine its food value. The pressure of duties prevented earlier attention. The package of "chicken corn" sent was subjected to analysis, with the following results:

Water	12.697	
Fat (either extra)	3. 13	
Carbohydrates (starch, &c.)	66. 50	
Albuminoids	7. 37	
Cellulose	6. 76	
Ash	3. 55	—100.00

Before discussing this plant, as to its feeding value, it would be advisable to say something explanatory of the plant itself. Botanically speaking, it is "sorghum vulgare," originating probably in Africa, but cultivated so long in eastern countries that its positive origin is obscure. "Sorghum vulgare" is a very variable species, more so than Indian corn. We know it in three well defined varieties—"broom corn," "sorghum" proper, and its associates, "Imphees," and the sample in question, "chicken corn." It is difficult to conceive that these are all forms of one and the same plant—but prominent botanists, after many attempts to separate them into distinct species, have concluded that there are no good distinctions by which to accomplish this, and hence have made them varieties of the same species of "sorghum vulgare."

These are unlike in many respects, but not more so than kale, cauliflower and kohl-rabi, which are now generally accepted as different forms of the same plant. Leaving "sorghum" and "broom corn" out of the question, our "chicken corn" is known under a variety of names, viz: "Indian Millet,,' "Great Millet," "Guinea Corn," "Negro Guinea Corn," "Chocolate Corn," "Durra," "Doora," "Doura," "Doro," "Daua." Since the plant is attracting considerable attention in the prairies, we would suggest the adoption of its now popular name of "Durra." As to its feeding value, we can find as many different and conflicting accounts from farmers who have used it, as it has names. An examination of analysis will show you that many of their conclusions were ill considered. The seeds of this plant are undoubtedly valuable as fodder, when supplemented by some highly nitrogenous subsistance, as cow-peas, cotton seed meal, &c. By examinations of the proportion of albuminoids to carbohydrates (including fat) we find them as 1:10, whereas, in oats they are as 1:5, and in corn 1—to less than 8. Rice is the only food product used by man with so low a nitrogen ratio. To use it then judiciously and economically it should be ground and mixed with peas or cotton seed meal. Let us examine the rational ration for milch cows and work horses or mules. From German experiments we are told that a cow weighing 1,000 pounds, live weight, will require for every twenty-four hours twenty-four pounds dry organic substance, 2.5 pounds albuminoids, 12.5 pounds carbohydrates, and .40 pounds of fat, and the nutritive ratio of albuminoids to carbohydrates should be 1-5.4. Let us see if we can not upon our farms use this chicken corn, in composition with other farm products, to make a full ration for milch cows. If we select common hay, made either from crab grass (Panicum Sanguinalis), swamp grass (Paspulum Leave) or barn yard grass (Panicum Crus Galli), the three varieties of grass which furnish us with most of our hay, we shall find by analysis that this hay will contain about 7 per cent. albuminoids, 40 per cent. carbohydrates, 2 per cent. fat, and 80 per cent. organic matter. Of these ingredients, it would be about right, we think, to claim 56 per cent of albuminoids, 63 per cent. carbohydrates, and 48 per cent. fat as digestible. Our cow-pea contains 22 per cent. albuminoids, 50 per cent. carbohydrates, 1.3 per cent. fat, and 80 per cent. organic matter. If the cow-peas and the "chicken corn" be ground, we can assume without much error that the entire amounts of all ingredients are digestible. Now, let us compound these substances, taking eight pounds chicken corn, five pounds cow-peas, and eighteen pounds common hay, as a daily ration, and we find:

	Org. mat.	Alb.	Carb.	Fat.
8 pounds chicken corn	6.72	.59	5.32	.25
5 pounds cow-peas	4.00	1.10	2.50	.07
18 pounds common hay	14.40	.80	4.53	.17
Total ration	25.12	2.49	12.35	.49
Total required	24.	12. 5	12. 5	.4

These three products are thus mixed so as to produce the proper feeding values.

A horse, moderately worked, will require every twenty-four hours, for every 1,000 in weight, 22.5 pounds organic substances, 1.8 pounds albuminoids, 11.2 pounds carbohydrates, .6 pounds fat; and in same way a proper ration may be compounded of these three, hay, peas and Durra.

The above analysis agrees very closely with those made by Professor Storer of broom-corn seed, (Bulletin of Bussy Inst., vol. 2, p. 99,) and with those made by Von Bibra, Sheir and Johnson, Pierre, Cossa and Voelcker, of the different varieties of "Sorghum Vulgare."

It is said that this Dourra bears a larger amount of seed per acre than any other cereal known. If this be so (and your experience may probably affirm it, it may be at no distant day a question of great commercial importance whether starch, glucose, and the various alcoholic drinks can not be more profitably made from Dourra seed, especially in the South, than from the more costly maize, which is now so largely consumed for these purposes.

In conclusion, I would say that these seed more nearly approach hay than oats or corn; and while not nearly so complete a food as either corn or oats, are yet of a decided value, and when supplemented with any niarogenous food, will make a good, palatable and cheap ration.

Yours truly,

WM. C. STUBBS.

APPENDIX.

The following notes are kindly furnished by Dr. P. H. Mell, Jr., Professor of Natural History and Geology in this College, who has kept an accurate Weather Report since February 1st, 1882, partly for the benefit of the College and partly for the Weather Bureau at Washington, D. C. A careful inspection of these notes, together with the results of the experiments already reported, may be of interest to our readers. These notes extend from February 1st, 1881, to March 1st, 1882.

	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Janary. 1882.	February, 1882.
Highest Barometer during month......	30.50	30.20	30.27	30.30	30.14	30.26	30.20	30.22	30.41	30.51	30.52	30.48	30.46
Lowest Barometer during month.......	29.75	29.62	29.80	29.82	29.74	29.83	29.64	29.73	29.92	29.90	29.86	29.84	29.61
Mean Barometer during month........	30.19	29.95	30.03	30.03	29.99	30.03	30.02	30.11	30.18	30.21	30.19	30.04	30.19
Highest Temperature during month ...	71	73	86	93	97	100	94	93	87	77	72	76	75
Lowest Temperature during month....	23	21	27	56	64	66	67	57	44	19	28	19	28
Mean Temperature during month......	49	50	62	73	79	81	78	76	69	54	50	52	53
Prevailing winds	W	W	W SW	S SE	WSWN	W N	E W	SE E	SE NW	E NE	SE E W	SW	SE
Winds followed by rain............	SW E	S SW E	SW SE	SE NE S	SW W	S SE W	E S W	SE	SE NW S	SW SE E	E SE SW	SW SE E	E S SW
Winds foll'd by clear or fair weather.	W	W NW	W	W	W N	N W	N W	N E W	NW E	W NE N	NW	NW W	NW W
No. of days on which cloudiness aver- 8 or more on a scale of 10.........	6	11	8	0	3	3	6	7	9	9	13	16	12
Total Rainfall during month..........	4.11	7.57	4.87	0.725	4.255	2.505	6.025	4.11	4.91	5.12	6.295	4.465	11.305
No. of days on which 0.01 or more inches of rain fell................	4	10	6	4	10	7	9	5	8	12	14	11	11

Auburn, Ala., is situated 826 feet above tide water, in Latitude 32 deg. 40 min. and Longitude 85 deg. 30 min.

Unusually strong winds occurred on the following days: March 17, April 6, May 9, June 7 and 17, August 14 and 20, December 14 and 29, January.

The number of perfectly clear days during the year was 29; fair days 126; cloudy days 210.

In January, 1882, the 22d was the only clear day, thus rendering this month the banner month of the year for cloudiness.

The first and only hail of the year fell on the 28th of February, 1882.

Frost occurred on the following days: March 4, 10, 22, 23, 30; October 26, slight; November 3, 8, 25, 26; December 24.

The last killing frost in spring was on the 30th of March.

The first killing frost in fall was on the 25th of November.

The plum trees began blooming on the 19th of February, 1881, and on the 21st of February, 1882.

The eclipse of the moon at 1 A. M. on the 11th of June.

On the 28th of June a comet made its appearance in the northern heavens.

The above table furnishes some food for thought. An inspection will yield the following results:

The coldest month of the year was February, 1881. The hottest month was July. The month of widest range of temperature was April—the difference between the maximum and minimum temperature being 59 degrees. The average temperature of the year was 65.6.

The thunder storms of the year dated as follows: February 11, 27; March 11, 16, 17, 18, 29; April 7, 12, 13, 26; May 3, 9, 10, 14, 24, 31, mostly without rain, June 7, 17, 18, 19, 25, 27, 30; July 25; August 14, 20, 21; September 10, 18, 26, 28; October 1, 30; December 13; February, 1882, 8 and 28.

The total rainfall for the year, beginning with February 8, 1881, and ending with February 8, 1882, was 61.02 inches.

The greatest rainfall on any one day of the year was 3.78 on the 14th of September.

The greatest monthly precipitation was 7.57 inches in March.

The dryest month of the year was May, in which month there fell but 0.725 inches of rain.

The prevailing wind during the year was from the west.